Informatics Institute of Technology
In collaboration with
University of Westminster, UK

Motion collision detector for automobiles-(McDAM)

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Submitted in partial fulfilment of the requirements for the
BSc (Hons) Software Engineering degree
Department of Computing

May 2018

Declaration

I confirm that this project report and all the facts associated with it is my own work that it has not been submitted in any previous application for a degree.

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Dedication

To my loving family...

Abstract

As a result of industrial revolution automobile industry has become a large requirement of people. Because of that road system also get developed all over the countries. There are some roads which are located in rural areas and not developed. There are some roads which are located in town areas with high traffic jams. Because of these reasons nowadays lot of accidents happen in the roads and highways. There are some cases where the necessary authorities are not informed in time, increasing the severity of the damages caused and it could also lead to casualties.

For decrease this risk, I came with an idea of Motion collision detector for automobiles. This system has the ability of identifying a potential accident through my Android mobile application. After a quick verification process by the driver, an alert along with the location details is sent to the necessary parties like the nearest police station and the closest family members.

Keywords: Android mobile application, automobile industry

Acknowledgement

My undivided respect and gratitude for the following people who guided me, motivated me and supported me to complete this project successfully.

- Mr Achala Aponso, my project supervisor for the continuous guidance and support I received from the very beginning itself.
- Mr Thilak Chaminda, our module coordinator for equipping us with knowledge required to accomplish the project objectives and meet deadlines.
- All the lecturers who guided me and feed me with knowledge.
- People who participated in the requirement elicitation campaigns.
- To the past seniors of IIT for sharing their knowledge and experience for the completion of the final year project.
- To my family and all the friends who was always supporting me through the good and bad days alike.

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List of Abbreviations

Abbreviation	Definition
OOADM	Object Oriented Analysis and Design Method
SRS	System Requirement Specification
SSADM	Structured System Analysis and Design Method
UML	Unified Modelling Notation
TOR	Terms Of Reference
UI	User Interface
GPS	Global positioning System
SMS	Short Message Service
GSM	Global System for Mobile

Chapter 01 - Introduction

1.1 Chapter overview

This section will give you the essential diagram of venture which has been embraced. To identify my project as a unique, First of all it will give a momentary overview to the problem domain. Then it will give information about existing related products to my project. The aim and objectives which are required for the successful completion of the task is examined in detail. Functional and non-functional requirements are discussed in this chapter and all the software and hardware requirements are mentioned here. The introduction will give you a concise thought and understand to allude the next chapters.

1.2 Project background

1.2.1 Problem Domain

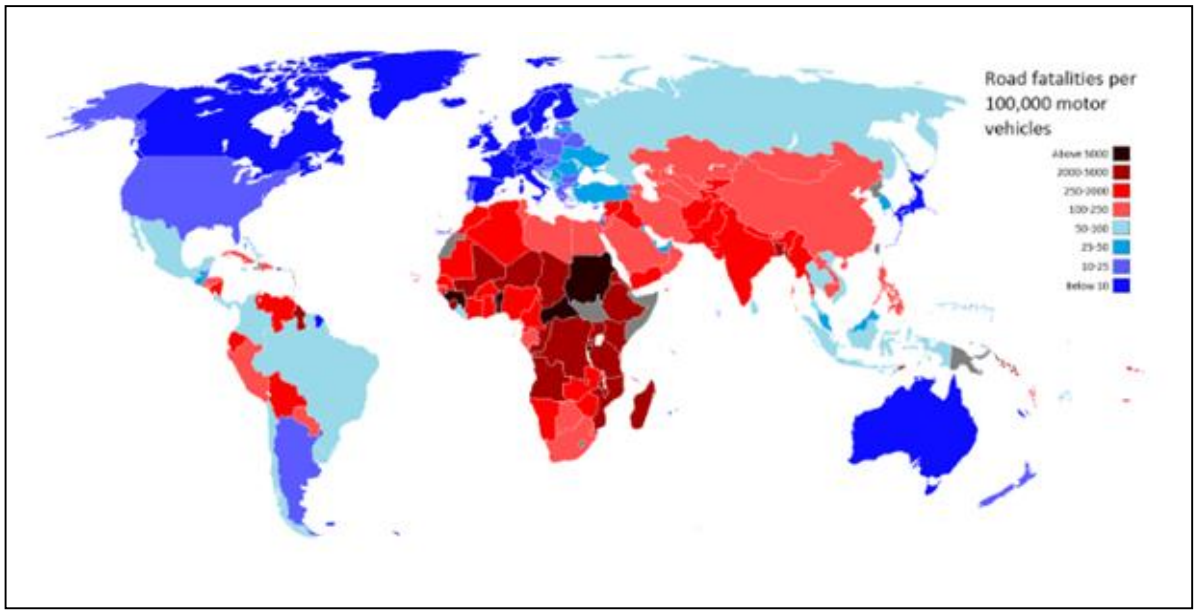

Figure 1 - Road fatalities per 100,000 vehicles

This Statistics show that nearly 1.3 million people die in road crashes each year, on average 3,287 deaths per day. That means road accidents has direct threat to the people who are travelling by vehicles. Not only that nearly 20-50 million people are getting injured or disabled due to motor accidents. *(J. R. Kwapisz, G. M. Weiss, and S. A. Moore ,2007)* Researchers says road traffic crashes ranked at the 9th leading cause of death and account for 2.2% of all deaths

globally. Besides road crashes are the leading cause of death worldwide among young people ages like 15-29 and the second leading cause of death worldwide among young people ages 5-14. Every year nearly 400,000 people under 25 die on the world's roads, on average over 1000 per day. Over 90% of all road fatalities occur in low and middle-income countries, which have less than half of the world's vehicles. That is why accident percentage relatively high on those countries. Therefore if the authorized offices, people or institutes are not going take an action for this situation, road traffic injuries are predicted to become the fifth leading cause of death by 2030. (National Highway Traffic Safety Administration (NHTSA), Dept. of Transportation US.(2014).Traffic safety facts 2012 Young Drivers.Washington (DC)

According to the Ministry of Transport and Civil Aviation in Sri Lanka, out of the 39,716 road accidents that were recorded in the year 2015, there have been 2801 casualties and 2590 fatal accidents.

These statistics could be reduced considerably if necessary actions could be taken without a delay. The proposed Vehicle Accident Identification and Alert System is shall be developed in order to address and provide a long-term solution for this issue.

1.2.2 System introduction

Nowadays a lot of accidents happen in the roads and highways. There are cases where the necessary authorities are not informed in time, increasing the harshness of the damages caused and it could also lead to casualties. To reduce this risk, we have come up with the idea of Motion Collision Detector for Automobile (McDAM). The system is capable of identifying a potential accident through the mobile application. After a quick verification process by the driver, an alert along with the location details is sent to the necessary parties like a main police station, a main hospital and the closest family members.

A main police station means mobile application send a message to a police base point and there is an admin to handle all the messages and send the information to the relevant police station A main hospital also has the same process which I mentioned in the.

In the Motion Collision Detector for Automobiles (McDAM), I am using the accelerometer of the (android) smartphone of the driver of the vehicle. It has the ability of detecting sudden changes of the velocity and acceleration of the mobile phone. The signals taken from this sensor would be then sent to a central processing unit of the application.

This signal shall trigger an alarm tone in the phone. If the driver is in a good state (not having any problems) or in case an accident hasn't occurred, the driver could turn the alarm off within a period of one minute. In the case an accident has occurred and the driver or any other passenger is injured, the alarm would be active for a minute and an automated message along with the location of the vehicle would be sent to the main police station, main hospital and the closest family member.

The GPS tracker of the smartphone shall provide the central processing unit of the application with the exact location of the vehicle at the point of the accident. Those coordinates would then be sent to the family member via SMS (GSM message) through the mobile application. Another message send to the police main station. Then the police station operator can view the GPS location of the relevant victim and notify the nearest police station to take the action for the incident. The following figure give you a graphical idea about the system.

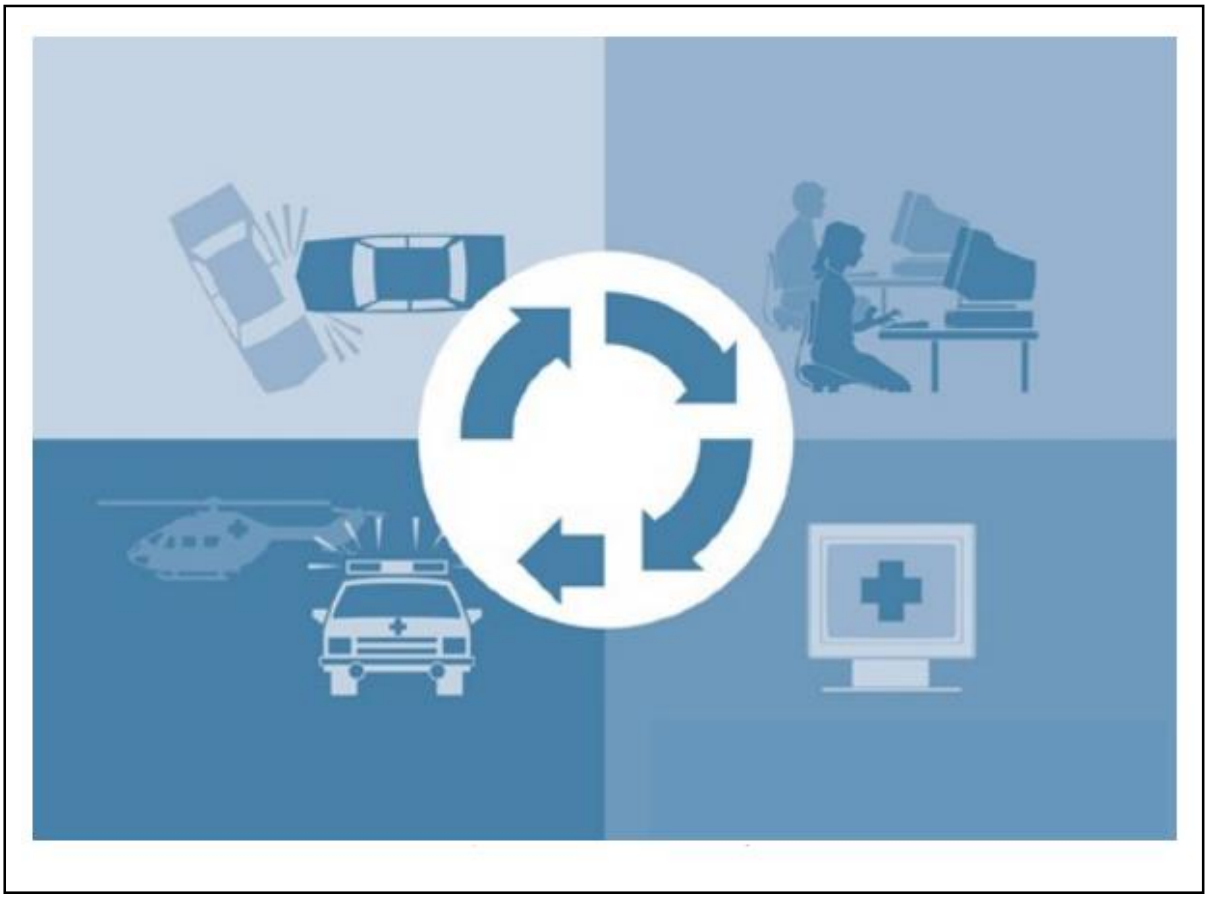

Figure 2 - graphical view of the proposed solution

1.3 Project Aim and scope

1.3.1 Project aim

This project's aim is to research, design, implement and evaluate a mobile application to reduce the death amount of the people from the motor vehicle accidents by informing immediately to the relevant authorities.

To further elaborate on the aim, this will be beneficial for the people who work on the transport industry, people who drive alone most of the times and normally all the people who drive vehicles. When an accident happens this application get the motion and evaluating the velocity changes. Then application trigger an alarm along with a message and if the driver or any person who is in the vehicle not responded to the warning message automated message send to the relevant parties.

1.3.2 Project Scope

The Vehicle Accident Identification and Alert System is based on the accelerometer of the smartphone identifying the occurrence of an accident. The verification of the driver or any other passenger is necessary for the system to confirm the occurrence of an accident. For an example, if the vehicle collided with a wall; the user is able to turn the alarm off so that it would prevent the system from sending an incorrect notification.

If there are injured passengers in the vehicle, the user shall be able to confirm the accident notification and let the nearest hospital know so that the hospital shall be able to send an ambulance. The police station would take necessary steps to contact the nearest hospital and fetch an ambulance along with the support team. If all the personnel involved in the accident has the mobile application installed and running in their smart devices, it would be easy for the control room in the police station to understand how many vehicles are involved and the intensity of the accident.

1.4 Project Objectives

In order to achieve the project aim and scope following project objectives have been taken.

1. Research on the project background including related existing project, products and evaluate the importance of project idea. The limitation identified from the research papers and improvements that can be done for this project.

Summaries of the research papers was used to create the Terms of Reference of the project and This would also give a huge opportunity to identify the aspect of the project, the scope of the project, the background of the project as well as the aims and objectives of the project.

2. Carry out a literature evaluation and prepared a review from the research of the following areas:
    - Evaluating existing products and projects in order to identify the development methodologies.
    - Evaluate the features of the existing related projects to consider the how my project should implement.
    - Evaluate the published research papers

3. Gathering the set of requirements from relevant authorities, expertise is in the project area by conducting an online survey or interviews. There was number of techniques to collect the requirements. (Interviews, research similar papers). Actually a requirement is a statement that an intended product that specifies how it should perform or how it should perform.

4. Decide the functional and non-functional requirements based on the conclusion which have been gathered from the literature review.

5. After identifying all the functional and non-functional requirements of the project, create a draft of a software requirement specification that consist the requirement evaluation which is going to take as a guidance to start the implementation.

6. Design the prototype of the solution is the next step of the project process. Every solution needs this important section to design prior to the implementation step.

7. Testing the prototype by comparing it with the requirement specification, in order to identify errors and to check for the accuracy and the performance of the results.

8. Evaluate the solution to identify the strengths and weaknesses of the project by using methods is the next step. Self-evaluations, expert opinions can be used as the methods

9. Documenting the final thesis including all the literature review, implementations, and designs.

1.5 Feature of the prototype

Proposed solution is consist with the following functional and non-functional features.

1.5.1 Functional features

1. User (driver or other passenger)
    - Verification of the accident
    - Registration in the system
    - View own profile and update details
    - Confirm/ reject accident notification
    - Use the Google map to search and view locations
    - View the speed of the vehicle
2. Police administrator
    - View accident location and details of the person
    - Identify and nearest path to accident location
    - Confirm the notification
    - Generate reports and graphical representations
    - Dispatch an inspection team
3. Hospital Administrator
    - View accident location and details of the person
    - Identify and quickest path to accident location
    - Confirm the notification
    - Generate reports and graphical representations
    - Show the availability of an ambulance that can be dispatched to the accident location

1.5.2 Nonfunctional features

1. Accuracy
    - Since the system involves with people at a very critical time in their lives, the accuracy of the system is a very crucial requirement.
2. Efficiency
    - The main goal of the system is to increase the efficiency and the effectiveness of the post-accident activities.
3. Accessibility
    - The system should be accessible for the users at all times for the maximum effectiveness.
4. Availability
    - Server of the system has to be available when the users use the system.
5. Portability
    - The mobile application should be portable because the users need to have it with them while they drive.
6. Maintainability
    - The system should support new updates and upgrades.
7. Usability
    - The system should be user friendly so that the non-technical operators and the system administrators can handle the functionalities without much hassle.
8. Security
    - The system should be secure because it contains user details.

1.6 Project Deliverables

- Terms of Reference
- Literature Review
- Requirement Specification
- Interim Report
- Prototype

- Prototype Report
- Draft Report
- Final Thesis

1.7 Resource Requirements

Following resources are identified in order to implement the project.

1.7.1 Hardware Requirements

Computer with 8GB RAM and core i5 processor.

To implement my project it required minimum 8GB ram because my main development IDE is android studio and it requires minimum 8GB ram.

1.7.2 Software Requirements

- Java JDK 1.8

  This would be the main programming language used for the implementation of the project. This is preferred over other languages as the author is very conversant with Java and many open source libraries which are needed for the implementation of the solution is compatible with Java.
- Android studio

  This solution is android based application. Therefore I am using android studio to implement the system. This IDE's usability is very high since this IDE mainly created for develop only android projects.
- Windows 8.1

  Windows 8.1 used as the main operating system here.

1.8Document structure

The chapters included in this project report is as follows

Chapter 2 – Literature Review

This chapter is contains a review of research articles and related documents regarding the problem background, technologies and related work carried out pertaining to the problem

domain. This will also evaluate the existing products to understand their strengths and weaknesses

Chapter 3 – Project Management

This chapter will provide information about the suitable project management methodology for this project. Time management, project planning and resource allocation details have been included in this chapter. The risks and the constraints of the system which identified will be discussed with a mitigation plan to overcome those risks

Chapter 4 – Requirements Specification

This chapter is consists of list of a functional and non-functional requirements gathered by analyzing requirements gathered from the stakeholders of the system using various kinds of requirement elicitation techniques.

Chapter 5 – Architecture and Design

This chapter will discuss both the high-level and the low-level design of the proposed solution. Various design diagrams drawn to model the proposed solution will be provided.

Chapter 6 – Implementation

This chapter will give you an idea about how the functional and non-functional requirements gathered during the requirement elicitation were implemented in the prototype. The problems which we found during the implementation and the solutions taken to overcome with the problems will be discussed in detail here.

Chapter 7 – Testing

This chapter includes the tests carried out during and after the implementation of the prototype.

Chapter 8 – Evaluation

This chapter consists of the evaluation of the project using various evaluation methods. It will critically review the evaluations carried out by the industry and domain experts and the author itself.

Chapter 9 – Conclusion

This chapter will describe how the initially specified aim, scope and objectives of the project were achieved for the success of the project, problems and the challenges faced by the author at each phase of the project, limitations of the research and the learning outcomes.

1.9 Chapter summary

This chapter provided a main idea of the project that's been undertaken. It provided detailed descriptions about the problem domain. The high level features of the prototype was also identified. The aim and objectives which are needed for the successful completion of the project was also provided in detail. It also identified the resource requirements of the project.

The next chapter will examines the Literature survey of the proposed Motion collision Detector for Automobiles (McDAM) application. Literature Survey will be carried possible and impossible approaches and features of the solution.

Chapter 02 - literature review

2.1 Chapter overview

The previous chapter contained a brief introduction to the project, problem domain and core features of the system. Also project Aim, Scope, Objectives were discussed. This chapter will discuss about the existing product reviews and how each directory analyses the products. Limitations in the existing product review directories will be discussed in this chapter. Also this examine the technologies and techniques which I have used for implement this project.

2.2 problem background

These days motor traffic is one of a major issue in world. The huge number of deaths and injuries proves the dark story of global motor collision crisis. Motor vehicles is being the second most leading reason for the deaths of people between ages of 5 and 29 and the third main reason for deaths of people ages between 30 and 44. According to a motor collision

statistical projection which hold in Europe 2011 and 2012 reveal that there is a 3% of increase in motor crashes. In 2011 it was 43,840 and it has increased into 45,337. Other than this 184,000 of young drivers between 15 -20 years were injured from collision accidents in 2012 and in 2011 this amount was be 180,000. (National Highway Traffic Safety Administration (NHTSA), Dept. of Transportation US.(2014).Traffic safety facts 2012 Young Drivers.Washington (DC) According to WHO (world health organization) more than 1.25 million people are dying each year because of the motor accidents and 20-50 million people are suffering from non-fatal injuries with many disabilities.

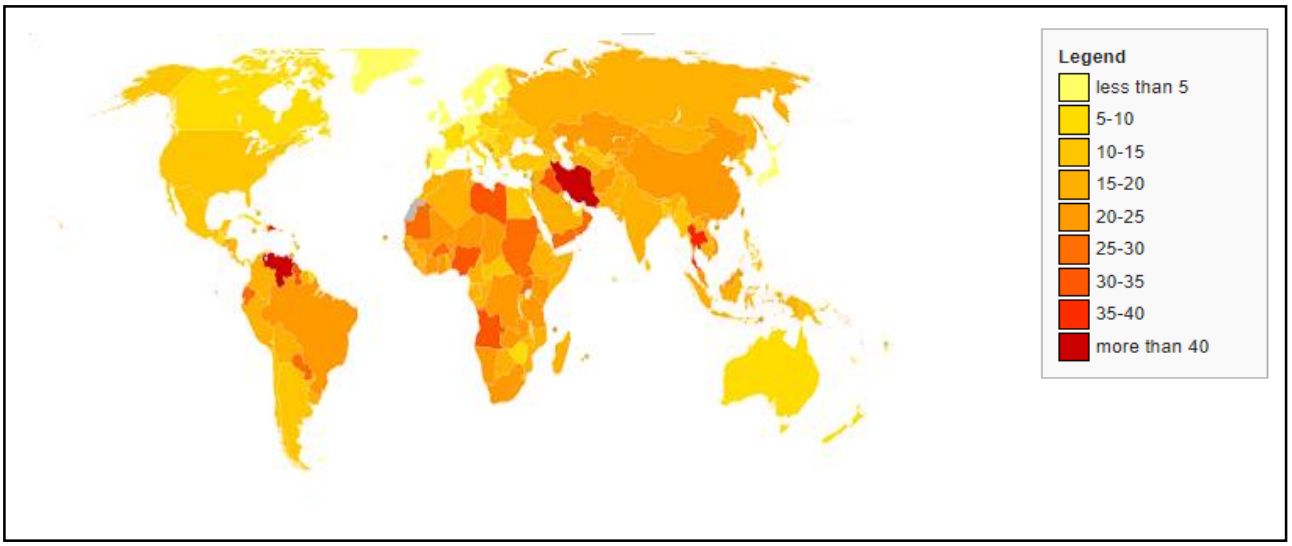

Figure 3 - deaths rates from road traffic accidents by country in 2012 per 100,000 inhabitants

According to This chart shows the death rates from the traffic accidents by country in 2012. This reveal out of 100,000 population inhabitant amount due to the motor accidents.

The major and obvious reason for the death of a victim is unavailability of quick recover, which is delay of the information about the accident in order to send an ambulance or relevant parties.in case of an incident of vehicle accident, responding time is for that incident is very important to send the emergency medical services for the victim. Actually responding time doing a huge impact on accident recover. Moreover each minute passed while in a crash without receiving any emergency medical care can make a huge impact on the victim. A research reveals that decreasing responding time by one minute occurs 6% of difference in the number of lives saved. (Evanco and William, M.(1996).The Impact of Rapid Incident Detection on Freeway Accident Fatalities.Virginia:Mitretek)

To Reduction of respond time, world experimenting on widespread implementations of traffic technologies. Earlier there was few related technologies to reduce motor accident deaths. Advanced traffic management system (ATMS) and automatic car accident detection system along with a notification systems are two example for that. ATMS consist with the sensors that use to detect the traffic and accident. Some of the sensors installed in highways and some of the sensors installed under the road such as loop detectors. (Peter T. Martin, Joseph P. and Hansen B.(2001).Incident Detection Algorithm Evaluation.USA:Utah Department of Transportation,Vol. 1, Issue 1, Part 122 of MPC report) However it was not get success as the expected because it rear to find the sensors in the road. Passengers could find the sensors in the highways often. Another fact is it expensive to install sensors in the road. Maintenance also bit expensive in that system. Due to some environment reasons like snowing, raining these sensors are not working properly. Other system of automatic accident detection system is available in the US manufactured vehicles. It consist with on board sensors to detect the accident and utilize the built in cellular to notify the relevant emergency parties. (Chris ,T. White ,J. Dougherty, B. Albright, A. and Schmidt, D.(2011).WreckWatch: Automatic Traffic Accident Detection and Notification with Smartphones.USA.PP. 285-303) However according to the evolution of the technology, it requires to upgrade the both hardware and software features. A system like this it is expensive when upgrading the both features. And the installation cost also high.

By evaluating these two systems which the author mentioned, many disadvantage can be figure out. Researches prove that it is so beneficial that if we can implement a system to reduce the time to rescue a victim using smartphone.

Using a smart phone these benefits can achieve.

- Smartphones users are upgrading their phones frequently. So the software and even the hardware also upgrading.
- Smartphone platform has more innovative technologies to exchange the information globally.
- Smart phones having the possibility of compact with new and various kind of sensors in order to develop traffic accident detection and notification systems.
- It is low cost of having a mobile phone compare to an existing traffic systems.
- Most of the time smartphones travelling along with their owners, providing accident detection regardless of whether or not the vehicle is equipped with an accident detection and notification system

(Hamid M. Ali,zainab s. and alwan.(2015).Car Accident Detection and Notification System Using Smartphone.Iraq:Information technology, Baghdad University,pp.620-635)

By evaluating these facts author came up with a solution for the traffic accident problem using smartphone. Description about the proposed system is available in the chapter 01.

2.3 Existing Product Review Directories

Since Motion collision detector for automobiles project is an innovative idea and different from usual management systems, author having a requirement to gather reliable information about the domain and the system. The author came across some similar systems and some research papers that provided, with an insight to the system. Few of them are listed below.

2.3.1 Using Smartphones to Detect Car Accidents and Provide Situational Awareness to Emergency Responders (Wreck Watch)

This research project explains about Wreck Watch, an accident detection system. The goal is to help reduce fatalities stemming from car accidents by decreasing the response time of emergency responders. Smartphones and their on-board sensors (such as GPS receivers and accelerometers) are promising platforms for constructing such systems. This research paper provides three contributions to the study of using smartphone-based accident detection systems. (WreckWatch., 2010)

- First, they have described solutions to key issues associated with detecting traffic accidents, such as preventing false positives by utilizing mobile context information and polling on-board sensors to detect large accelerations.
- Second, they have presented the architecture of the prototype smartphone-based accident detection system and empirically analyse its ability to resist false positives as well as its capabilities for accident reconstruction.
- Third, how smartphone-based accident detection can reduce overall traffic congestion and increase the preparedness of emergency responders is discussed.

2.3.2 Crash Notification System for Portable Devices (CNSmotors)

Crash Notification for portable device presents an early crash notification system that can be implemented in handheld and aftermarket devices. This system features a crash detector, which can be connected over a wired or wireless link. Systems and services are at an increasingly

developed to improve quality of service, safety and the environmental impact of the road traffic system. In wireless technologies, intelligent systems are arising to help develop safety and efficiency services for road transportation. The box hosts the notification (message) service, which sends Minimum Set of Data to the Server Center. In this approach, real-time location data are collected by Global Positioning System (GPS) mobile phones to track vehicles traveling on roads. So, that they can save the injured peoples as soon as possible. Smartphones and their onboard sensors (such as GPS receivers and accelerometers) are promising platforms for constructing such systems. (CNSmotors,2011)

2.3.3 Car Accident Detection and Notification System Using Smartphone

Every day around the world, a large percentage of people die from traffic accident injuries. An effective approach for reducing traffic fatalities is: first building automatic traffic accident detection system, second, reducing the time between when an accident occurs and when first emergency responders are dispatched to the scene of the accident. Recent approaches are using built-in vehicle automatic accident detection and notification system. While these approaches work fine, they are expensive, maintenance complex task, and are not available in all cars. On the other hand, the ability to detect traffic accidents using smartphones has only recently become possible because of the advances in the processing power and sensors deployed on smartphones. Most of the smartphone based accident detection systems rely on the high speed of the vehicle (extracted from the smartphone GPS receiver) and the G-Force value (extracted from smartphone accelerometer sensor) to detect an accident. As many references assure that 90% of road-traffic accidents occur at low speed of the vehicle. Hence, in addition to the high speed accident detection, this paper concentrated on low speed car accident detection. The main obstacle that encounters the low speed accident is how to differentiate whether the user is inside the vehicle or outside the vehicle, walking or slowly running. The effect of this obstacle is minimized, in this work, by a proposed mechanism that distinguishes between the speed variation of low speed vehicle and walking or slowly running person. The proposed system consists of two phases; the detection phase which is used to detect car accident in low and high speeds. The notification phase, and immediately after an accident is indicated, is used to send detailed information such as images, video, accident location, etc. to the emergency responder for fast recovery. The system was practically tested in real simulated environment and achieved quite very good performance results.

2.4 Related implementation ideas

Other than these products I have found many related project ideas through research papers.

1. According to the (National Highway Traffic Safety Administration (NHTSA),(2006).Emergency information notifying system, and apparatus, method and moving object utilizing the emergency information notifying system, 2006) research paper they have come up with an another related idea. The authors describe a system that gathers vehicle data and sends it to a centralized database in case of an accident. Upon a trigger signal the accident is detected though one or several sensors located in the vehicle. When researching this idea we can consider that they are going to use hardware devices in order to implement their idea because in their research paper they mention that they using various kind of sensors which they going to attach into the vehicle body. Using those sensors it detects some responses and checking whether it is an accident or not. Then it trigger an alarm.

2. A system that notifying the status of a moving object in terms of images of the object and its surroundings data of collisions and temperature of the object and its positioning to third parties over a radio link. This status is notified to insurance and roadside assistance companies whenever a collision is detected. (European Committee for Standardization , (2008) . Road transport and traffic telematics ESafety - ECall minimum set of data))

   This idea bit related to the proposed solution because basically this system also having the proposed idea's concepts, but here this system detecting more facts other than velocity changes. This project collecting images of the collision and temperature status and surrounding data. Here also using hardware devices like sensors to collect details.

3. The author (E. Dávila, et al., 2007) published a research paper define another different idea that related to collision prevent area. Here the author present an automatic emergency alert system for mainly two wheel vehicles that includes an accident detector of inclination sensor and decision unit and a system to inform third parties about historic data of speed, acceleration and braking. Somehow, these solutions are not available in all vehicles, and the proprietary of the car makers and service providers. European e-Call initiative will solve this problem by embedding an in-vehicle eCall platform that will launch an automatic voice and data call to the pan-

European emergency service in case of an accident. This service, which is expected to be offered in all new four-wheeled vehicles by 2010, will provide E112 with information about the vehicle and its location. The e-Safety Forum's e-Call Driving Group is responsible for e-Call's implementation recommendations.

2.5 Limitations in existing solutions

All the evidence and evaluations from the previous sections reveal that there are many constraints in the existing collision detecting systems which in result does not provide the user with the most accurate immediate help by analysing the user reviews given. The limitations identified are listed as below.

- Users have to attach some hardware devices (sensors, accelerometer) in the vehicle body

  Currently when author analysing the existing project ideas author could find that most of the projects are consist with the hardware devices. Negative side about this fact is sometimes those equipment may not works due to some environment or some other reason. Therefore author can't keep an accurate responsibility on those systems. Considering this fact users (customers for the product) has to spend another amount on those hardware items.

- Use many changes to detect an collision

  When referring the related research papers author was able found not only the velocity change but also temperature, crash images and surrounding use for detect an accident. (European Committee for Standardization, (2008). Road transport and traffic telematics ESafety - ECall minimum set of data) this project containing these features. After collecting all the necessary information system will determine whether this is an accident or not. Let's say someone use this system and facing to an accident but unfortunately system unable to gather one required detail. Then user won't be able to get an immediate help from the application.

- Unavailability feature of send the accident report to the nearest relevant places

  Sending the collision report is to the nearest police station, hospital automatically is a vital feature for an application like this. Though author referred many number of

research papers and author was unable to find a project which contain with this feature. This is a very valuable feature. If a nearest police station or a nearest hospital able to get the collision message directly from the application they can reach to the accident place immediately. Then if the driver or the other passengers are having critical damages to their lives, there is a high possibility to get rid of those damages. But author could find this limitation while referring research papers.

2.6 Limitations on the McDAM project

Due to the time and resource constraints, author had to define some limitations to the system development. They are briefly described below.

- Motion collision detector for automobiles (McDAM) does not prevent or reduce the number of accidents that take place. It merely increases the effectiveness of the post-accident activities and thereby, aids in saving lives and minimizing the impact of the delays in responses of the parties like the police stations and hospitals.
- The system does not support usage in two wheelers. The smart device needs to be fixed in a holder for the mobile application to function properly. Furthermore, the acceleration changes of the vehicle are measured relative to the plane the vehicle is travelling. Therefore, the detection of an accident would not be truly accurate when it comes to two-wheelers.
- The accident alert is sent to the relative through a SMS. For this to function properly, the GSM signal strength should be powerful. At first, I had planned to provide the relative with a mobile application for receiving the alerts. But then the relative may have to be online all the time. Furthermore, it also requires the usage of a smart device. But simply enabling the relative to get a SMS solves both the above mentioned issues.

2.7 Techniques

2.7.1 Techniques to proposed system

The core functionality of proposed system is detect the collision accurately. In the inbuilt related products they have multiple sensors which install in the system. Through those sensors they can detect many number of details such as acceleration, deceleration, airbag deployment and vehicular rollover metrics of a collision vehicle using electronic control unit. (M. Alsliety.(2009). How does SDR fit the telematics model:usa) Since most of the people are using

android inbuilt sensors it can detect the forces and accelerations with a car collision. As shown the figure below the android smart devices also detect the same required details as an ECU vehicle collision detector. (white et al., 2010)

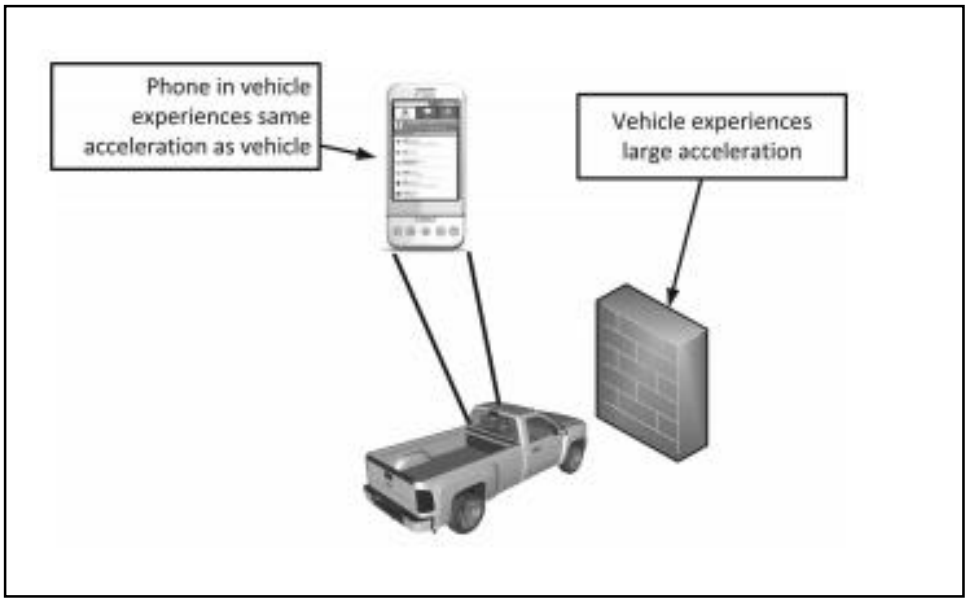

Figure 4 - Device Sensors Provide Acceleration Information

During the accident, smartphone gathering the same forces and accelerations experienced by the passengers of the vehicle. If the smartphone can experiencing the details of a collision relatively to the occupants of a vehicle, smartphone can use the experienced data in order to recreate and model the forces which detected.

Since author is using android mobile to implement a collision detecting system, there can be more false collision detections during travelling in the vehicle. Therefore it is a key challenge to avoid them and detect the accurate data. There are many reasons to detect false attempts from the smart mobile. During a fall of a mobile in the vehicle, sudden stop of a vehicle and when smartphone carried out of the pocket cause for false data detections. (white et al., 2010)

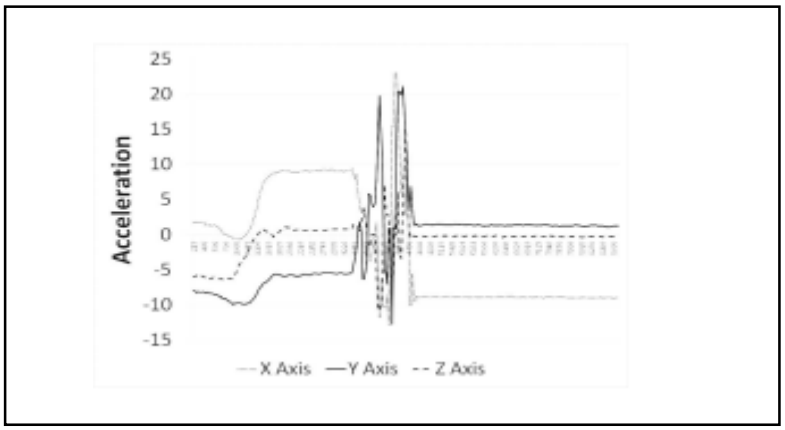

Figure 5 - Acceleration during a fall

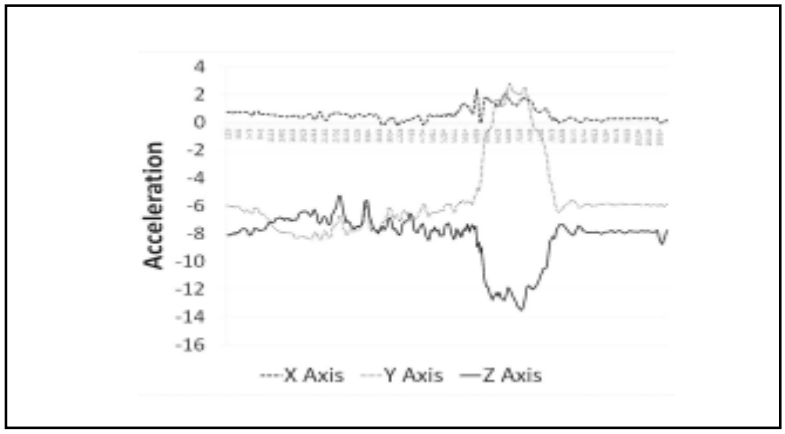

Figure 6 - Acceleration during a Sudden Stop

This testing performed in a real vehicle. It reaching to the approximately 25 mph of speed. Then suddenly stopped the vehicle. P.s: performed (tested) speed is approximately similar to the exact speed and braking pressure was not exactly calculated. Figure shows the acceleration experienced on each axis during the stop. As author mentioned, the smartphone remained stationary relative to the vehicle, it experienced the same forces as the vehicle. In this case, the acceleration calculated by the smartphone was actually less than that experienced during the fall. So we can avoid this motion. (white et al., 2010)

The result attributes reveal that, although vehicle stop was sudden and forceful, the vehicle (consequently android mobile) came to rest from a period of a time which was longer than during the drop of the phone. That means change of the velocity was greater. But the actual acceleration was less because the change happened within a longer period of time. So it can avoid those false attempts of the smart phone.

From using all these techniques, proposed system can be implement with high level of accuracy.

2.7.1.1 IOT attempt on the system

These days Internet Of Things (IOT) having a huge attention from the researches. It is affecting to the humans life in a huge manner because it is allowing communications between object machines and every human requirements with the people. IOT represents a system which consists of things in the real world, sensors attached or combining things, connected to them Internet via wired and wireless infrastructure. The IOT sensors can use things of different kind technologies such as RFID, Wi-Fi, Bluetooth and ZigBee, in addition to allowing a large area connect using many technologies such as GSM, GPRS, 3G and LTE. Things will enable IOT Sharing information about the state of things and the environment surrounding people, Software systems and other devices. Through Internet technology things, the world will become smart in all aspects because Internet things will provide a way for smart cities, smart healthcare, smart homes and Building, in addition to many important applications such as smart power, network, transportation, and waste Management and monitoring. (Mohammed , j .and Ahmed ,a.(2017). Internet of Things Applications, Challenges and Related Future Technologies .sudan: Electrical and Electronic Engineering Department, Red Sea University)

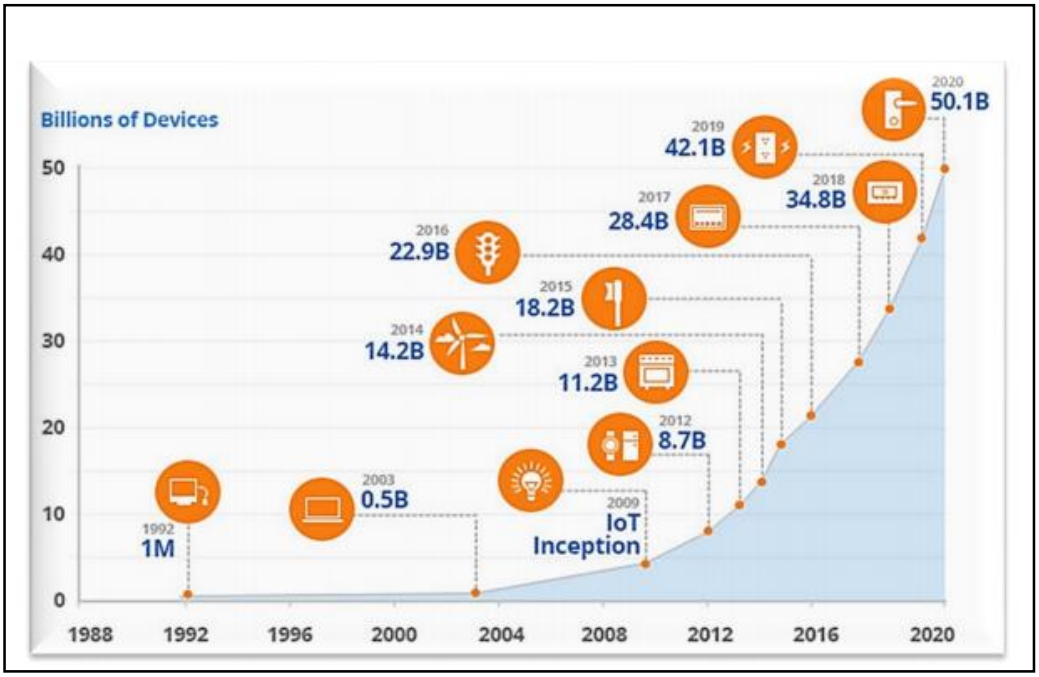

Figure 7 - Internet of things growth

This figure show that the growth rate of the IOT devices. As you can see IOT did a huge impact on these days innovations. IOT having ability of connect to most of the platforms. Other than that it provide many services such as notification, security, energy saving, automation, communication, computers and entertainment. Figure that mention below is show the concept of the IOT in a good way.

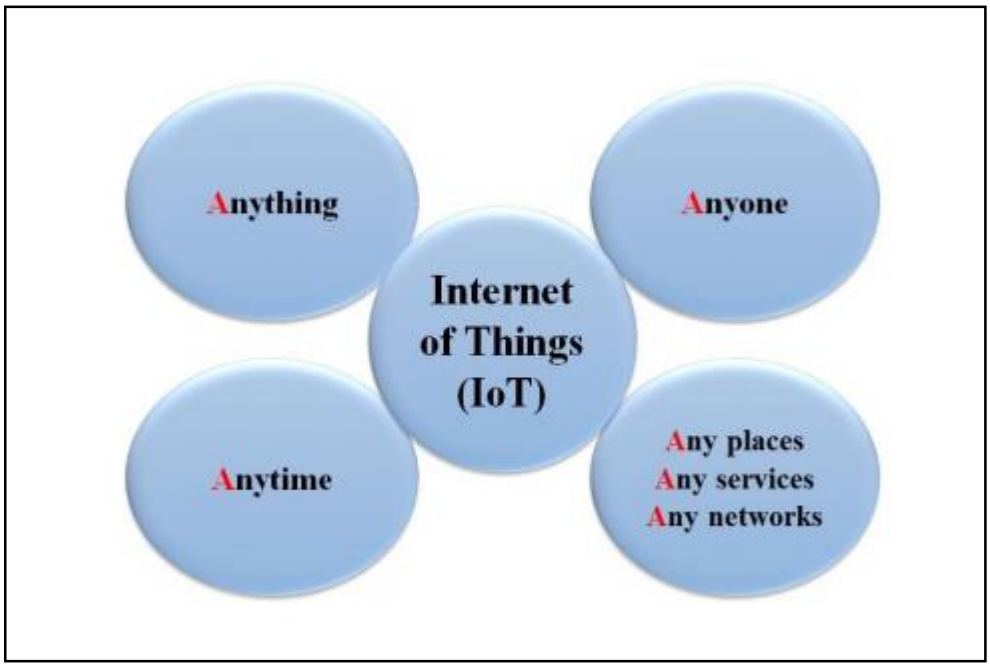

Figure 8 - Internet of things concept

Since this proposed solution having IOT concept there are challenges like other concepts. Some of them are data volume, data interpretation, security and privacy.

2.8 Chapter Summary

This chapter has given a brief explanation about problem background of my proposed system. Problem domain described there and some failed attempts related to my proposed solution are explained there. This chapter explain in-depth review to figure out the requirements and features of the existing related products and the improvements which we can implement in my proposed system described in a good way. Then existing products, existing ideas mention there. Then the limitation of the existing products are describing here. Techniques which we used here explained. About IOT research concept, there is a brief explanation mention at last of this chapter.

The next chapter will discuss about the project management methodologies about the project.

Chapter 03 – Methodology

3.1 Chapter Overview

This chapter describes about the project methodology process of the proposed solution. As this is a research based project, the requirements may change over the course of the project and managing the scope, time, cost and resources will be difficult. So having a methodology structure in place would be vital to achieve the aims and objectives of the proposed solution. Evaluating existing development process models and justification of picking one of them is described in this chapter. Other than that Work Breakdown Structure, Gantt chart, Monitoring plan and Project risks are presented as well.

3.2 Development Methodologies

Software Development Methodology is a process used in software development to achieve various aims related to the project. Refinement and apply the development methodology will help the author to plan and manage the development process effectively throughout the development phase of the project. Here are some basic development methodology used in software development and validation of use and not to use them for the proposed solutions.

3.2.1 Waterfall Methodology

The waterfall is one of the most affirm the development of methodologies that are used. This sequential approach whereby presented at each stage of the process as a separate phase is disposed in a linear sequential order. This method is based on good planning and produces informative documents. Each stage of the waterfall methodology has its own outcomes and begins only after the previous step has been completed.

Waterfall Methodology should be used only when all the requirements are clear, understandable, and it is unlikely to change much in the development stage. Since this model has a rigid structure, it is very difficult to accommodate changes after the start of development. Therefore, this method does not suit development project, as it is worked out on the basis of, and must have a lot of changes in the development process.

3.2.2 Prototyping

Prototypes methodology that evolved from the need to better define the specifications and it entails the construction of a demo version of the software, which includes the important functions. Baseline characteristics are determined only to provide enough information to create a prototype. A prototype used for clarifying the technical characteristics, it acts as the base line

for communication between team project, and the project owner. Prototypes are built for rapid development process and most of the time they ignore the best programming practices.

3.2.3 Agile Methodology

Agile methodology based on additional and iterative development, where requirements and solutions evolve with the combination between cross-functional teams. They are best suited for applications where requirements change rapidly in the course of development. Agile does not suit a lot of the proposed solution, as it is difficult to scale up to large projects where documentation is important.

3.2.4 Spiral Methodology

Methodology spiral risk driven approach, where the process is represented as a spiral rather than a sequence of actions. It has been designed to include the best features of the waterfall and prototyping and introduced a new component to a risk assessment.

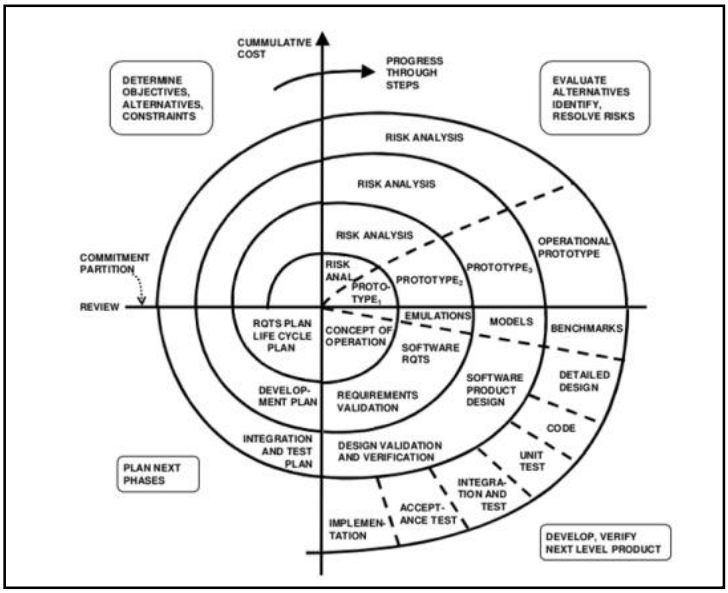

Figure 9 - Spiral Methodology

Each loop in the spiral model is divided into four sectors. They are

- Objective Setting
  The objectives and risks for that phase of the proposed project are represented.

- Risk assessment and reduction

A detailed analysis is conducted for each of the identified project risks and steps are taken to eradicate those risks.

- Development and validation
  A process model for the system is chosen after all the risks are evaluated.

- Planning
  The project is reviewed and a decision is made whether to continue with further loop or not.
  (Barry.2007)

3.2.5 Research Methodology

Research project on the basis can be mainly in two directions. Deductive research will try to test the theory that already exists. Inductive research will generate new theories and hypotheses from data collected after the observations. Since the proposed solution is based on a prediction on the current behaviour of the candidates, the author will take the deductive approach.

3.3 Project Planning

This research is an Undergraduate project that expand for about 8 months and being done by an individual author. Within the project period the author has to face various kind of interruptions and risks that will affect the final output. So proper project planning protocols needs to be implemented so ensure a good output can be delivered before the deadline. Set of milestone needs to be identified in the early stages and the total workload needs to be separated into sub tasks and assign appropriate time slots for them.

3.3.1 Work Breakdown Structure (WBS)

Work Breakdown structure is provided in Appendix I

3.3.2 Gantt chart

Gantt chart is provided in Appendix II

3.4.3 Time Allocation

The following table shows the main tasks and the amount of time allocated for each task of the project.

No	Task	Duration	Start date	End date
01	**Initial research**	**27 days**	**8/22/17**	**9/27/17**
01.1	Identify the research area	10 days	8/22/16	9/2/17
01.2	Identify the problems of the researched area	10 days	8/29/17	9/9/17
01.3	Finalize project topic and the area	10 days	9/10/17	9/22/17
01.4	Project topic selection form submission	3 days	9/23/17	9/27/17
02	**Project initialization**	**15 days**	**9/28/17**	**10/13/16**
02.1	Feasibility study	3 days	9/28/17	10/01/17
02.2	Finalize project topic	2 days	10/02/17	10/04/17
02.3	Identify the aims and the objectives	3 days	10/04/17	10/07/17
02.4	Identify features of the prototype	1day	10/08/17	10/09/17
02.5	Prepare of project initial document	2 days	10/10/17	10/12/17
02.6	Project initial document submission	1 day	10/13/17	10/13/17
03	**Literature review**	**15 days**	**10/16/17**	**10/31/17**
03.1	Read research papers	3 days	10/16/17	10/19/17
03.2	Identify approaches	1 day	10/20/17	10/21/17

03.3	Identify technologies		10/20/17	10/21/17
03.4	Identify techniques		10/20/17	10/21/17
03.5	Evaluate existing solutions	1 day	10/22/17	10/23/17
03.6	Review articles	2 days	10/24/17	10/26/17
03.7	Preparation of literature review	3 days	10/27/17	10/30/17
03.8	Submission of literature review	1 day	10/31/17	10/31/17
04	**Project management**	**8 days**	**11/01/17**	**11/8/17**
04.1	Identify project management methods	2 days	11/01/17	11/02/17
04.2	Identify project monitoring plan	2 days	11/03/17	11/04/17
04.3	Identify risks	2 days	11/05/17	11/06/17
04.4	Define risk mitigation plan	2 days	11/07/17	11/08/17
05	**Requirement gathering and analysis**	**22 days**	**11/09/17**	**11/30/17**
05.1	Identify requirement elicitation techniques	2 days	11/09/17	11/10/17
5.2	Execution of selected elicitation techniques	2 days	11/11/17	11/12/17
05.3	Analysis of gathered requirements	2 days	11/13/17	11/14/17
05.4	Analysis of models	3 days	11/15/17	11/17/17
05.5	Identify functional/non- requirements	2 days	11/18/17	11/19/17
05.6	Define the scope	2 days	11/20/17	11/21/17

05.7	Prepare requirement specification report	8 days	11/22/17	11/29/17
05.8	Submission of requirement specification report	1 day	11/30/17	11/30/17
06	**Interim report submission**	**3 days**	**12/01/17**	**12/03/17**
07	**Design**	**20 days**	**12/04/17**	**12/23/17**
07.1	Define high level architecture	7 days	12/04/17	12/10/17
07.2	Prepare design diagrams	6 days	12/11/17	12/16/17
07.3	Prepare detailed design	6 days	12/17/17	12/23/17
08	**Implementation**	**60 days**	**12/24/17**	**02/20/18**
08.1	Implementation of prototype	40 days	12/24/17	02/09/18
08.2	Preparation of prototype report	9 days	02/10/18	02/19/18
08.3	Submission of prototype report	1 day	02/20/18	02/20/18
09	**Testing**	**20 days**	**02/09/18**	**02/28/18**
09.1	Prepare test plan	10 days	02/09/18	02/18/18
09.2	Unit testing	2 days	02/19/18	02/20/18
09.3	Functional testing	2 days	02/21/18	02/22/18
09.4	Performance testing	4 days	02/23/18	02/24/18
09.5	Analysing of testing	2 days	02/25/18	02/28/18
10	**Evaluation**	**20 days**	**03/01/18**	**03/20/18**

10.1	Identify the evaluation methods	10 days	03/01/18	03/10/18
10.2	Critically evaluate the system	10 days	03/11/18	03/21/18
11	**Conclusion**	**10 days**	**0/21/18**	**03/31/18**
12	**Submission of draft project report**	**90 days**	**01/01/18**	**04/01/18**
13	**Final report submission**	**113 days**	**01/01/18**	**05/02/18**

Table 1 - Time allocation

3.4.4 Risk Management

Possible risks and measures should be taken to reduce these risks is necessary to determine at an early stage of the project as a precaution. The following tables summarizes the actions of mitigating the risks

Risk ID	Risk	Mitigation	Risk Level
R01	Inconclusive system requirements	Identify and validate system requirements by researching and seeking expert advice	Medium
R02	Not meeting project deadlines	Prepare a time management plan and follow it with caution	High
R03	Lack of technical expertise and experiences in the domain model	Refer various study material and attain knowledge about the research domain and tools and technologies related to it Seek supervisor advice	Medium

		Gain domain background knowledge using requirement elicitation techniques	
R04	Corruption and loss of data because of hardware and software failures	Backup all the project data using an online repository like or in another source	High
R05	Work interruptions because of health issues and emergencies	Allocation of extra days and enough gaps between the sub tasks when plan project planning	Medium

Table 2 - project risks

3.5 Chapter Summary

This chapter discussed about the importance of project management development methodologies. The author presented the importance of development methodologies and the existing development methodologies. After assessment on spiral methodology was chosen as the preferred design methodology, as it satisfies the requirements of the proposed solutions. Later, the author discusses the importance of project planning, the project-based studies. Work Breakdown Structure, Gantt chart and timing performances were also well represented. Likely risks and mitigation plans for them were highlighted as they affect the final outcome of the project significantly. In the next section, the author will discuss about the software requirements specification for the proposed solutions.

Chapter 04 – Software Requirement Specification

4.1 Chapter overview

Previous chapter presented an overview of the methodology phase which described development methodologies, time management, research methodologies and risk management.

Software requirement specification will give a brief idea about the requirement engineering phase of the project. The functional and the non-functional requirements of the system will be identified through different requirement gathering methodologies. After that, find the suitable requirement gathering techniques and collect the user requirements using them. The requirement gathering methodologies used, different types of stakeholders of the system along with their respective roles will be discussed. Analysis models will be modelled to clearly demonstrate the functional and non-functional requirements of the system. Use case diagrams are used to construct the requirement.

4.2 Stakeholders

A stakeholder of any systems is any internal or external person or entity that can affect or is affected by the said system (Boundles, 2016). Stakeholder can be a person, company or organization. Identifying the stakeholders of the system is very important part in the requirements gathering process. And they can be affect the system negatively or positively. Therefore the system admins should consider about this fact.

4.2.1 Onion model

The Stakeholder Onion Model outline the proposed solution maps the stakeholder's relationship to the product i.e. it shows how the stakeholders are categorized and how they interact with the system (BAwiki, 2016). The stakeholders and their roles in the proposed solution is depicted in the onion model given below.

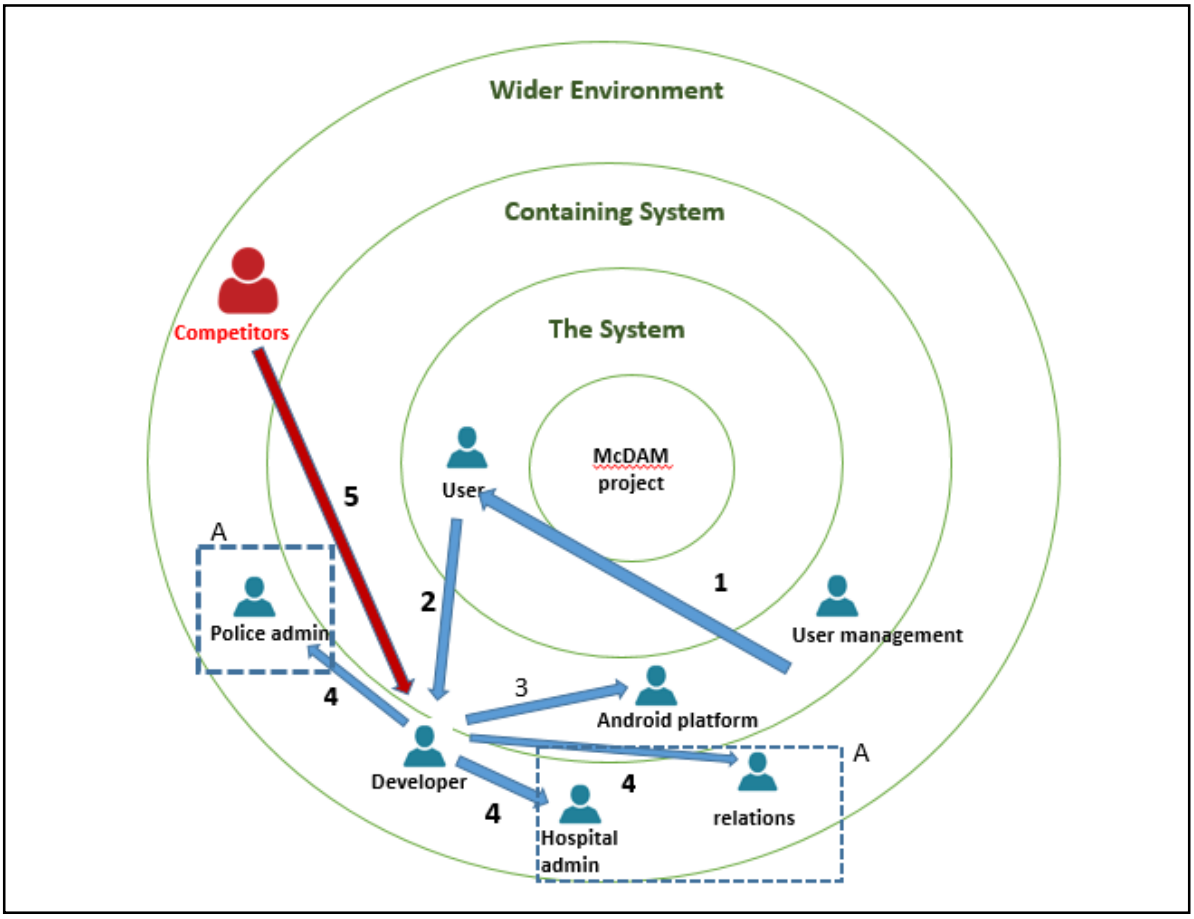

Figure 10 - Onion model of the system

According to the onion model, all the pressure point were listed below

Pressure point no:	**Description**
1	User management should take the responsible of the good management of the system.
2	Developer should be able to deliver a user friendly and accurate system. That is the main responsible of the developer
3	Android platform means , since this is an android based project developer has to deal with the android environment.(android playstore, development technologies)

4	Developer has to work with the relevant authorities (police, hospital) in order to get success of the project
5	Developer should make sure that the system is unique and stands out when compared with competitor products by producing results of high accuracy with high performance

Table 3 - Pressure points of the system identified

P.S: two of the boxes which I named "A" are same.

4.3 Description of Stakeholder roles

Viewpoint of the stakeholder roles are described below.

Operational stakeholders

Stake holder	**View point**
Developer	Deliver an user friendly and finely working system
Police admin	Take immediate action when a collision message received
Hospital admin	Take immediate action when a collision message received

Table 4 - Operational stakeholders of the system

Functional beneficiary

Stake holder	**View point**
user	It is reliable and easy to use application

Table 5 - Functional stakeholders of the system

Regulatory and enforcing

Stake holder	**View point**
Android platform	Distribute a user friendly application to the customers

User management	Manages the system process

Table 6 - Regulatory and enforcing stakeholders of the system

Financial beneficiary

Stake holder	View point
Developer	To develop a perfect application within the budget and time constraint.
User management	Manage the system for future benefits

Table 7 - Financial beneficiary stakeholders of the system

4.4 Requirement Elicitation process

Requirement gathering is the process of gathering what are the customer requires from the system. Out of the numerous requirement elicitation methodologies, a few were used to gather requirements for this project. Questionnaire, Interviews and Research similar products) are some of those. Requirement is a statement that an intended product that specifies what it should be or how it should perform. There are functional and non-functional requirements in every system. We are using the requirement elicitation methodologies to figure out those.

The utilized requirement elicitation methodologies are describe below along with an overview of the factors that led to choose those methods.

4.4.1 Literature survey

A literature review of a product is giving the knowledge about the existing products review systems and the techniques, technologies and approaches used by them to review software products. The purpose of selecting this method was to identify the research gaps in the existing products and how to improve the proposed solution in order to address the gaps. But author figure out that, this method has not only advantages but also disadvantages there.

Advantages	Disadvantages
• Well documented and easy to refer • Critically evaluated • contain with extra knowledge	• Time consuming

Table 8 - advantages and disadvantages of literature survey

4.4.2 Questionnaire

A general questionnaire was prepared to gather the problems faced by end users when choosing a software product according to user reviews for their need. "The questionnaire is used to identify the usability requirements. Questionnaires are a well establish technique for collecting demographic data and user s' opinions" (Preece, 2007). The questionnaire is provided in Appendix III. This questionnaire's purpose is gather the end user requirements for an accurate solution in order to deliver a user friendly final product. This method also consist with advantages and dis advantages. Some of them mention below.

Advantages	Disadvantage
• Low costs • Automation and real time access • Less time • Convenience for respondents • Flexibility of the survey.	• Limited sampling and respondent availability • Difficult to understand questions

Table 9 - advantages and disadvantages of Questionnaire

[Blog]cventguest. Available at:https://blog.cvent.com/author/cvent_admin/[accessed 16 Apr.2018]

4.4.3 Interview

Interviews are one of the best and easiest way to gather the requirement. Using the experts in the relevant area we can conduct an interview to gather requirements.

Normally when doing interview, huge questions Unconscious, Compound Questions are avoided.

Advantages	Disadvantage
• It is easy to gather requirements • Easily can clarify the facts • Can gather the implementation guidance	• Limited time constraint

Table 10 - advantages and disadvantages of Interview

4.4.4 Self Evaluation

To identify the difficulties encountered by users in choosing the best software product for any need by reading user discussions, several self-observation sessions is so accurate. In this way, the developer will be able to understand the difficulties encountered with the systems for reviewing existing products. The system context and to identify further requirements that could be included in the proposed system, able to overcome the limits identified.

Advantages	Disadvantages
• Low costs • Flexibility	• Limitations on knowledge

Table 11 - Advantages and disadvantages of self-evaluation

4.5 Requirement Analysis

The requirements that we gathered from the techniques will be analyse here.

4.5.1 Justification of requirement elicitation

Literature review explores several solutions that use similar approaches to the proposed solution. Existing systems are assessed for information on what to follow and what to avoid, such as the limitations of different approaches to automation approaches and the challenge of using natural language for the development of test scripts, to develop effective solutions with minimal pitfalls. Information obtained through literature review is used to establish the basis of the process of formulation of requirements.

The online survey was then created based on the results of the literature review. According to the literature review survey, an online questionnaire survey has been created to gathering

information from different stakeholders. The questionnaire was done by online using Google doc. author used it to gather data and analysis data. The survey is presented in Appendix III. The questionnaire link was distributed among friends and relations. Questions were created by covering all the required areas in order to gather well summarized details.

Interviews were conducted with few experts in the relevant areas. Each of them representing a functional beneficiary of the system. From each individual was asked few compressed questions in order to clarify the requirements and resolve ambiguity. The interviews provided basic outline regarding the current trends. It was also included in writing the specification based on the theme in the view of each stakeholder.

Results obtained through the execution of requirement elicitation techniques mentioned above would be discussed in the next section.

4.5.2 Limitations on the questionnaire

- Questionnaire was distributed among many number of people. Some of them were not much familiar with the vehicle.
- Some of them (email receivers) not replied.
- Gathered results may not represent the entire end users perspective.

4.5.3 Questionnaire evaluation

$$\text{Success Result Rate} = \frac{\text{survey successfully done members}}{\text{Participated Members}} * 100$$

$$= (122/140) * 100$$

$$= 87.1\ \%$$

Author received an 87.1 % of user responses for my questionnaire, generally it was successful. Some users have not provided responses properly. Those data filtered and got the required data.

4.5.4 Quantitative Results

1. What mobile platform you are using?

   The results that gathered from the questionnaire can be presented as percentages. According to the results 70.7% people using android mobiles, 22.1% using IOS mobiles and 7.1% using windows mobiles. Majority of the people using android phones. Therefore author decided to develop my solution in android platform.

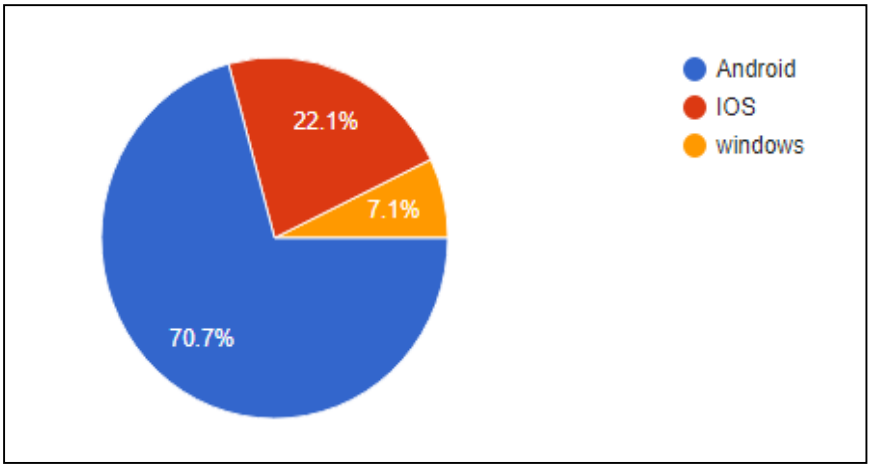

Figure 11 - mobile operating systems of the responses

2. Have you ever consider about a system to get immediate help in a motor accident?

   Majority responded for this question answer "yes" and rest answered "no". 70% of them responded "yes" and another 30% responded "no". Author created this question to get know about do people having a requirement upon my proposed idea because if the majority doesn't need this kind of solution, it's not worth of implement this type of a system. As a summary it's happy to say that people having an imagination, idea and requirement related to my solution.

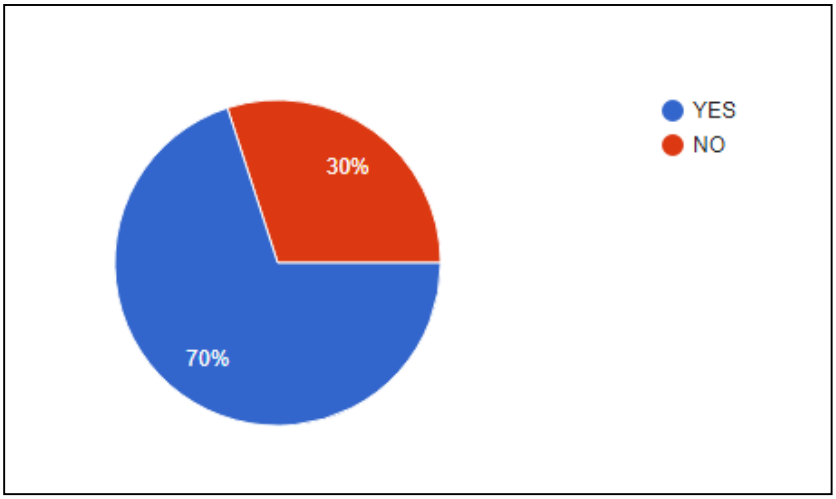

Figure 12 - Having idea about a system related to (McDAM)

3. What kind of system do you like to get an immediate help in an accident?

Initially author had an idea to implement solution using hardware. After literature review author recognized there are some products which experimented upon this solution but some of the reviews from the people were not good. Maintenance and difficulties were the reasons for that. Afterwards I realized that if I can implement my idea as a software product it will appreciated by people. The result on this question was 78.6 % were responded for a software product and another 21.4% responded for a hardware solution. According to majority, author ended up with an opinion to develop software solution for this.

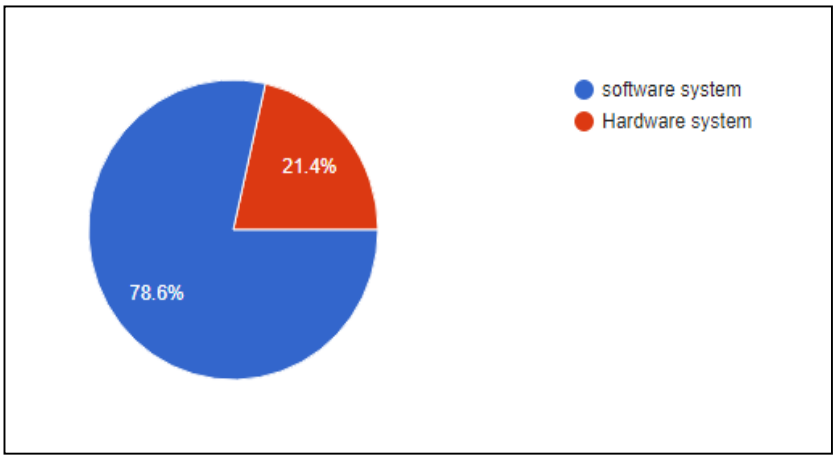

Figure 13 - Choice of the solution platform

4. Do you think you that you can get a help when an accident happens as you expect?

To identify the importance of my solution author included this question because if the people are not having a trust on a product like this, there is no worth of doing such a project like this.it is happy to say that majority responses 78.6% answer "yes" and rest of them also responses 21.4% "maybe" as the answer. There was no at least one responses for "no".

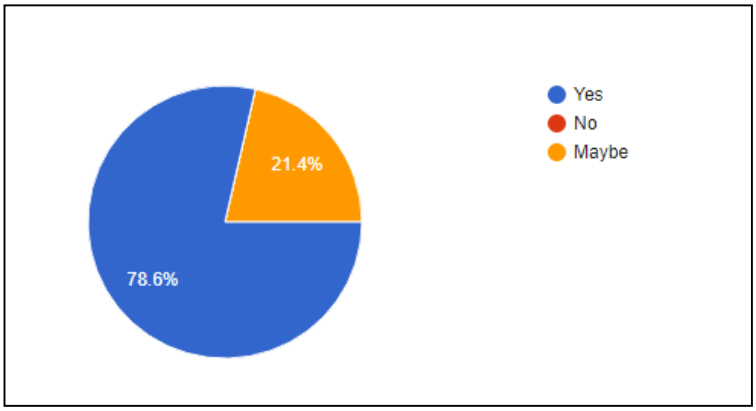

Figure 14 - trusting level of the proposed system

4.5.5 Interviews

Interviews were conducted with some relevant experts like police officers, doctors, university students and motor mechanical industry people. Author chose these parties because these industries have some relation between my solutions. Author asked several different questions from each and every industry experts to gather various kind of ideas and information.

4.6 Analysis Models for the System

Model the requirements of my proposed solution author has used two well-known approaches namely Object Oriented Analysis and Design Methodology (OOADM) and Structured System Analysis and Design Methodology (SSADM). OOADM describe requirements through an object oriented approach, hence its name. Interacting objects of the system are modelled using various diagrams in OOADM. In contrast, SSADM, which is process oriented, uses the data flow and functional views in order to analyse system requirements. If SSADM is used as an analysis methodology for the proposed solution, it is necessary to use the top down approach of functional decomposition. The system would have to be broken down into separate functions repeatedly until they are small units (Senn, 1989). SSADM is a time consuming task and the smaller aspects will be ignored during the analysis. It is also difficult to determine the stage where functional decomposition should be terminated and development should be commenced. Additionally, the waterfall approach followed in this methodology provides no mechanism to reverse to a previous stage in the software development life cycle once it is completed (Wu and Wu, 1994).

4.6.1 Use Case Diagram

Use case diagram is shown functionalities which will be implement in the prototype. After gathering the requirements of the system and evaluating them, the functionalities of the system was identified along with the internal and external entities influencing the system and their interactions (Creately Blog, 2016)

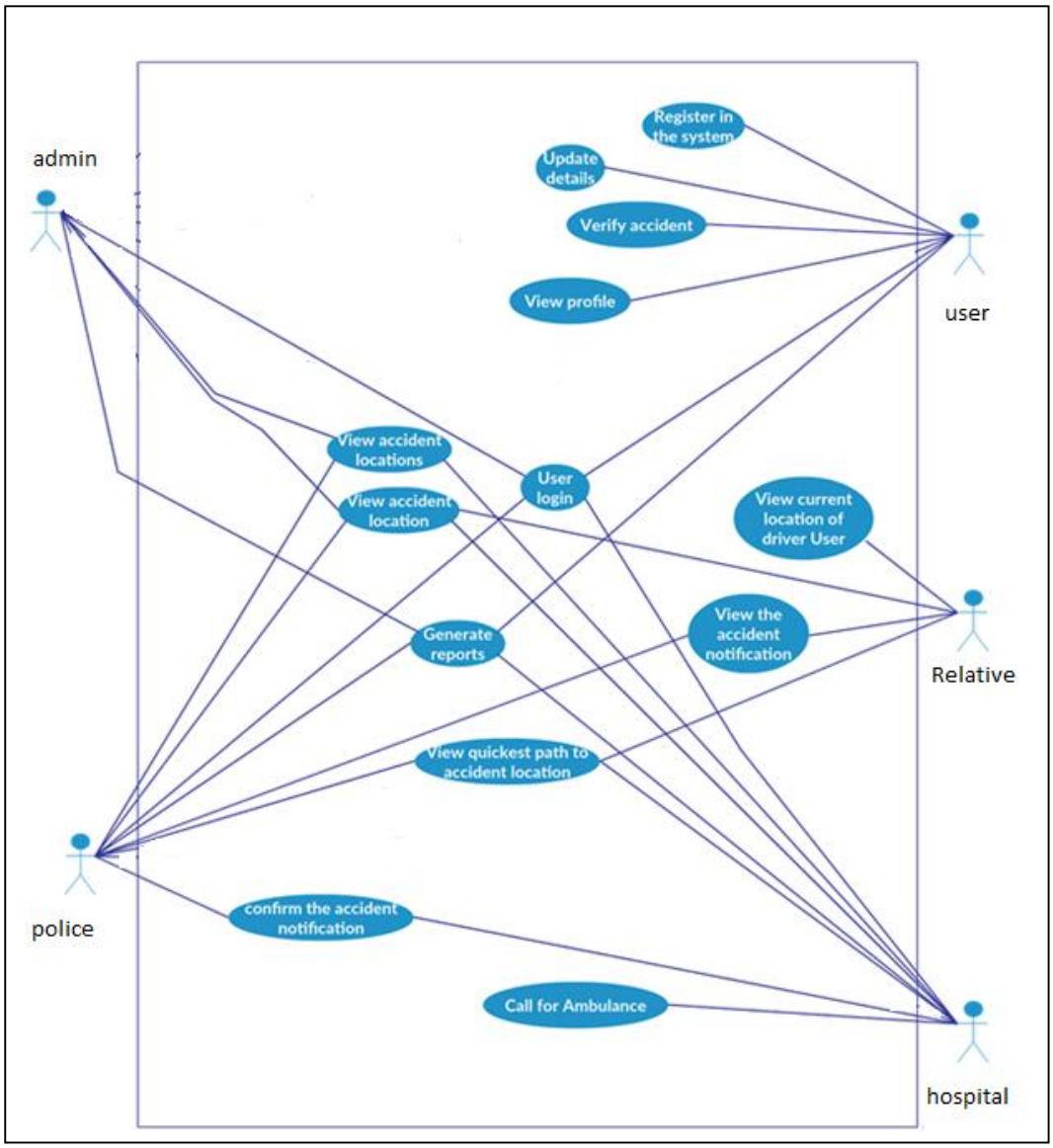

Figure 15 - use case diagram

User can register in the application by giving required details and he can get ready to use the system. User can update the details of the profile. When an accident happens it will generate the report and send to the relevant parties. Police and hospital having bit same operations to do. Receiving the accident notification, view the location after confirming the details about the report they can send details to the nearest stations. Relatives also receiving a report and then they can get to know about the situation and take the relevant actions.

4.6.2 Domain model of the system

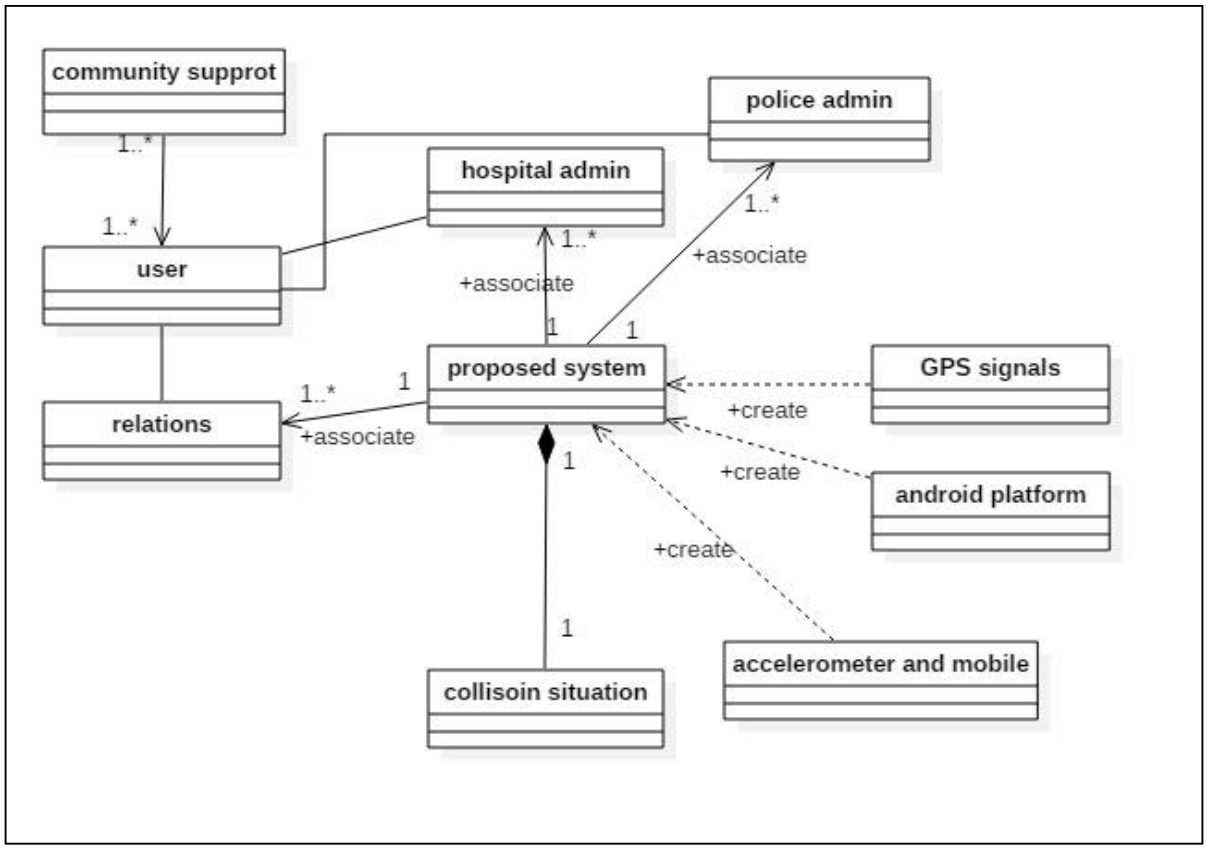

Figure 16 - domain model of the proposed system

This domain model of the proposed system is outline the conceptual view, data and behaviour of the system. The domain model given in the above figure depicts the relation of the objects in the system to each other. Those GPS signals, android platform, accelerometer are the most important dependent objects in the system. Proposed system (solution) receive the data of a collision situation. Other police admin, hospital admin, relations are main responders to the proposed system. User (driver or passenger) will get thee recover through those responders. Here I have declare community support class. If a people who near by the victim can help the victim directly. The relationship between these entities as mentioned is clearly shown in the domain model.

4.6.3 Activity diagram of the proposed system

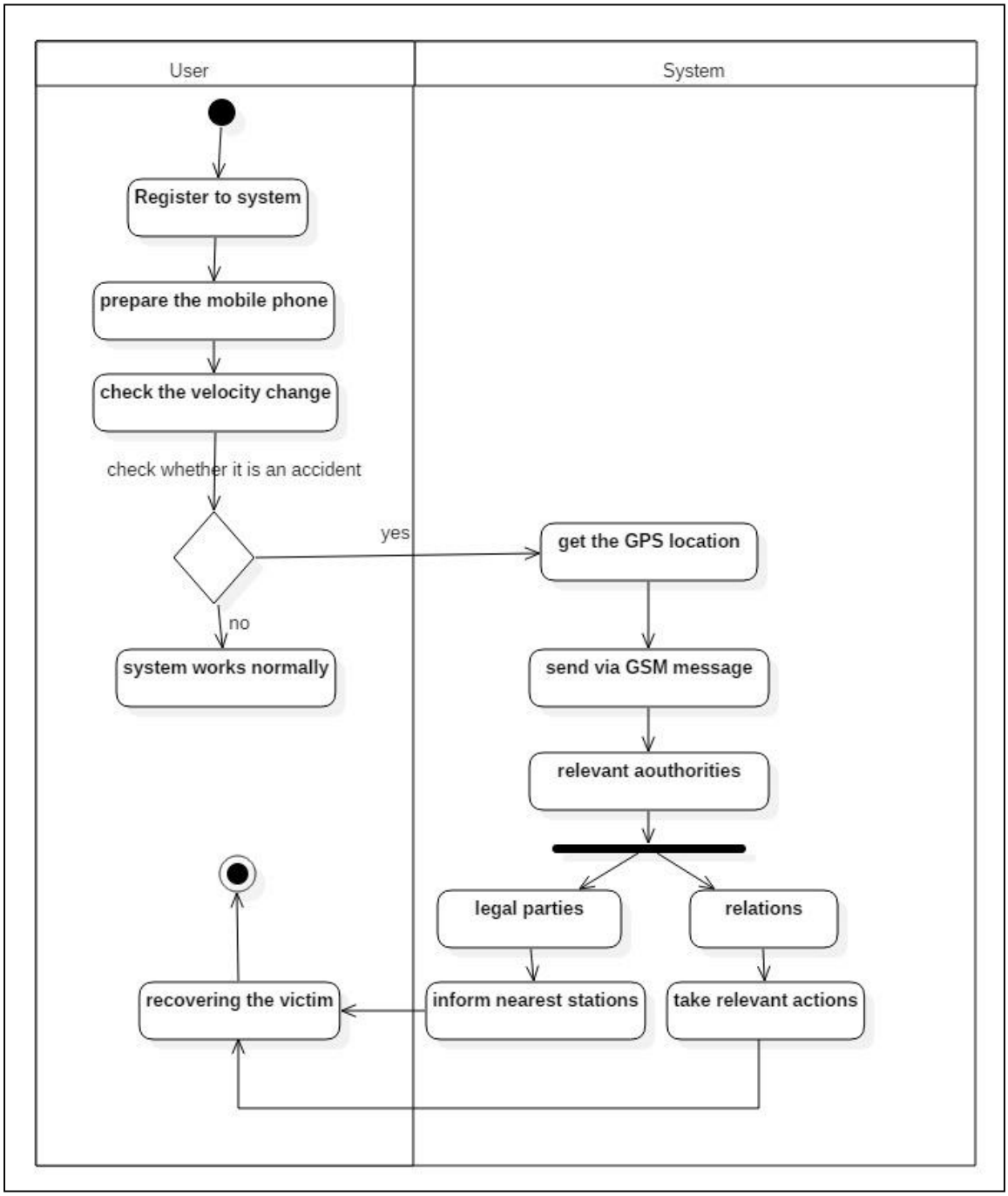

Figure 17 - Activity diagram of the system

Activity diagram drawn for the proposed solution's system context. The activity diagram of the system is describing the functionality of the system. It is represents the flow of the system from one activity to another activity.

4.7 Functional and Non-functional Requirements

Functional requirement is that specifies what system should do. Functional requirements will be able to identify by using use case diagram. Non-functional requirement represent how the system should behave. Also non-functional requirements represent all the remaining requirement which are not belongs to the functional requirements. Non-functional requirements helps to implement a good system consists with such as Scalability, Availability, Maintainability and Usability

The Functional requirements and non-functional requirements are prioritized in to three Categories such as High, Low and Medium.

4.7.1 Functional requirements

Functional requirements are list in the table below

ID	Requirement	Description	Priority
FR01	Registration in the system	On order to use the system user has to register in the system	High
FR02	View own profile and update the details	User should be able to check his entered details and update option should be there.	High
FR03	Confirm or reject the notification	User has to reject or confirm the accident notification which popping up in the system	High
FR04	Use the Google map to search	Get the accident place have to use the most accurate map system of google maps.	High
FR05	View the accident location	After send the accident message to relevant parties they should be	High

		able to see the location of the accident	
FR06	Identify the nearest path and nearest station to the accident place	After identifying the nearest stations admins can send the people to the accident place immediately	Medium
FR07	Dispatch the inspection team	To recover the victim authorities should send inspection team	High

Table 12 - functional requirements

4.7.2 Nonfunctional requirements

ID	Requirement	Description	priority
NFR01	Accuracy	Since the system involves with people at a very critical time in their lives, the accuracy of the system is a very crucial requirement.	High
NFR02	Efficiency	The main goal of the system is to increase the efficiency and the effectiveness of the post-accident activities.	Medium
NFR03	Accessibility	The system should be accessible for the users at all times for the maximum effectiveness	Medium
NFR04	Availability	Server of the system has to be available when the users use the system.	High

NFR05	Portability	The mobile application should be portable because the users need to have it with them while they drive.	Medium
NFR06	Maintainability	The system should support new updates and upgrades	High
NFR07	Usability	The system should be user friendly so that the non-technical operators and the system administrators can handle the functionalities without much hassle	Medium
NFR08	Security	The system should be secure because it contains user details.	Medium

Table 13 - Non-functional requirements

4.8 Refining the scope

After the requirement gathering and analysis of the requirements for the identification of functional and non-functional requirements of the system, the scope of the project has been improved.

4.9 Chapter summary

In this software requirement specification chapter, initially the stakeholders of the system were identified. Then the elicitation techniques such as using online questionnaires, interviews, observation along with the knowledge obtained from the literature were utilized in gathering requirements from the stakeholders. Graphical and quantitative charts were obtained through these procedures. Activity diagram, use case diagram, domain model was used for the graphical requirement analysis. Final result from the requirement analysis then used to implement the proposed system prototype.Next chapter will give a System Architecture and Design outline of the project, which will be focusing on the system design of the prototype from the gathered functional and non-functional requirements.

Chapter 5 - System architecture and Design

5.1 chapter overview

Previous chapter is discussed about requirement elicitation techniques, functional, non-functional requirements, and few graphical representation of requirements and analysis of the gathered requirements. Here specially will be discuss high level and low level architecture of the system. The high-level design will describe the system design including the system architecture. It will describe the relationships between various system modules and functions of the system. The low-level design will define the relationship between the classes and the functions of them to meet the desired requirements of the solution. All the design aspects providing here by using UML diagrams. Class diagrams and sequence diagrams are used to represent the details. At last UI designs will provide and describe the features of the prototype.

5.2 Design Methodology and Tools

Design methodology can be used to conceptualizing the requirements of a proposed solution into a software implementation. The best suitable design methodology that can be adopted for implementing the solution is identified according to the requirements. For selecting a design methodology for a system depends on factors such as requirements of the user, type of the solution and the development environment process. Though there are many umber of design methodologies, here used Structured Systems Analysis and Design Method (SSADM) and Object-Oriented Analysis and Design Method (OOADM). Basically (SSADM) is process oriented, uses the data flow and functional views in order to analyse system requirements. OOADM expresses requirements through an object oriented approach to analyse the requirements. After evaluating these two methods author ended up with these two conclusions.

1. For the function oriented software projects SSADM is a very suitable design methodology. From this SSADM we can't handle very large software systems.

2. For the object oriented projects OOADM is very suitable. Because main it focuses on the objects in a software. The very important feature of this OOADM is it can use for very large software. By breaking down the complex systems into small components it delivers a very reusable objects.

These two methodologies has both advantages and disadvantages. Author has listed down some of them below.

SSADM advantages and disadvantages

Advantages	Disadvantages
Understandable is very high.	Ignoring the non-functional requirements
Not using often	Consist with process oriented
	Users requirements are not touching

Table 14 - SSADM advantages and disadvantages

OOADM advantages and disadvantages

Advantages	Disadvantages
Development time is low	Classes and objects can't figure out easily

Table 15 - OOADM advantages and disadvantages

When we comparing advantages and disadvantages of these two methodologies there are several huge differences. As you can see SSADM graphical representations are easy for the developers because they rich in understandable. So the developers can save their time for the developments. When considering about the disadvantages about SSADM, it has high percentage in disadvantages. Ignoring the non-functional requirements is a huge disadvantage in here and also there are several disadvantages in there.

When we comparing SSADM with the OOADM, OOADM is best for a solution. OOD methodologies used here in order to analyse the requirements.

5.3 High level design

High level design represent the overview of the system. It outline the end goals of the proposed solution and define the process that need to implement the system.

5.3.1 Rich picture

The rich picture for the proposed system is given below. It analyse the summery of the proposed system.

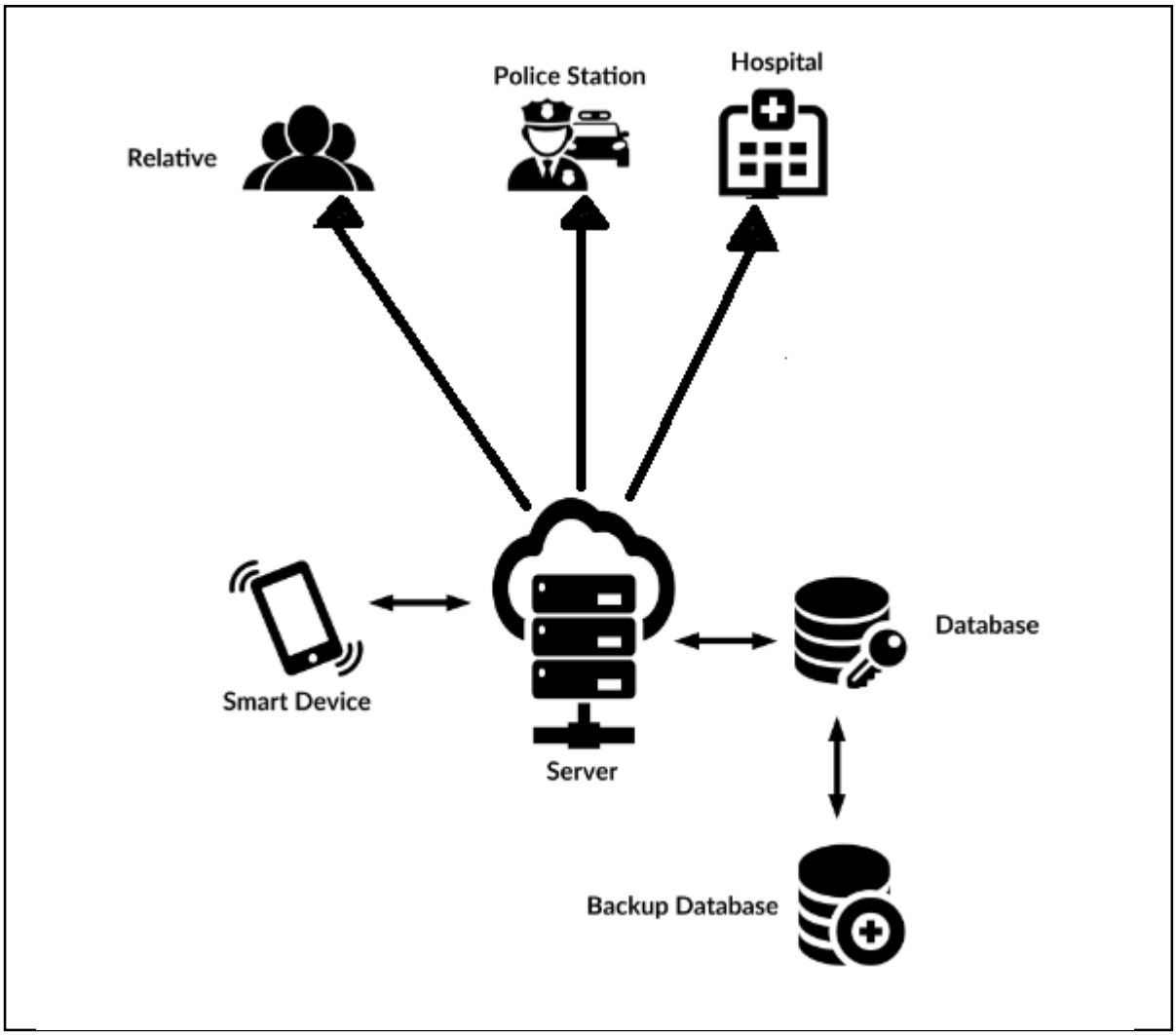

Figure 18 - Rich picture of the proposed system

The smart device detect the velocity change of the collision using the internal hardware of the smart device. From the GPS it detect the location and sending all the details into the server. Then the server store and process the details which received and it sending the details to

relevant authorities. That is the main outline of the proposed system which describe on the rich picture.

5.3.2 High level architecture

High level architecture for the proposed system has given below. The three tier architecture is used here since it is a well-known design pattern and a well establish system architecture. There are many benefits when use this concept. These three tiers aren't depend on each other and it is easy figure out three stages of the system. Therefore author used three tier concept to model the proposed system.

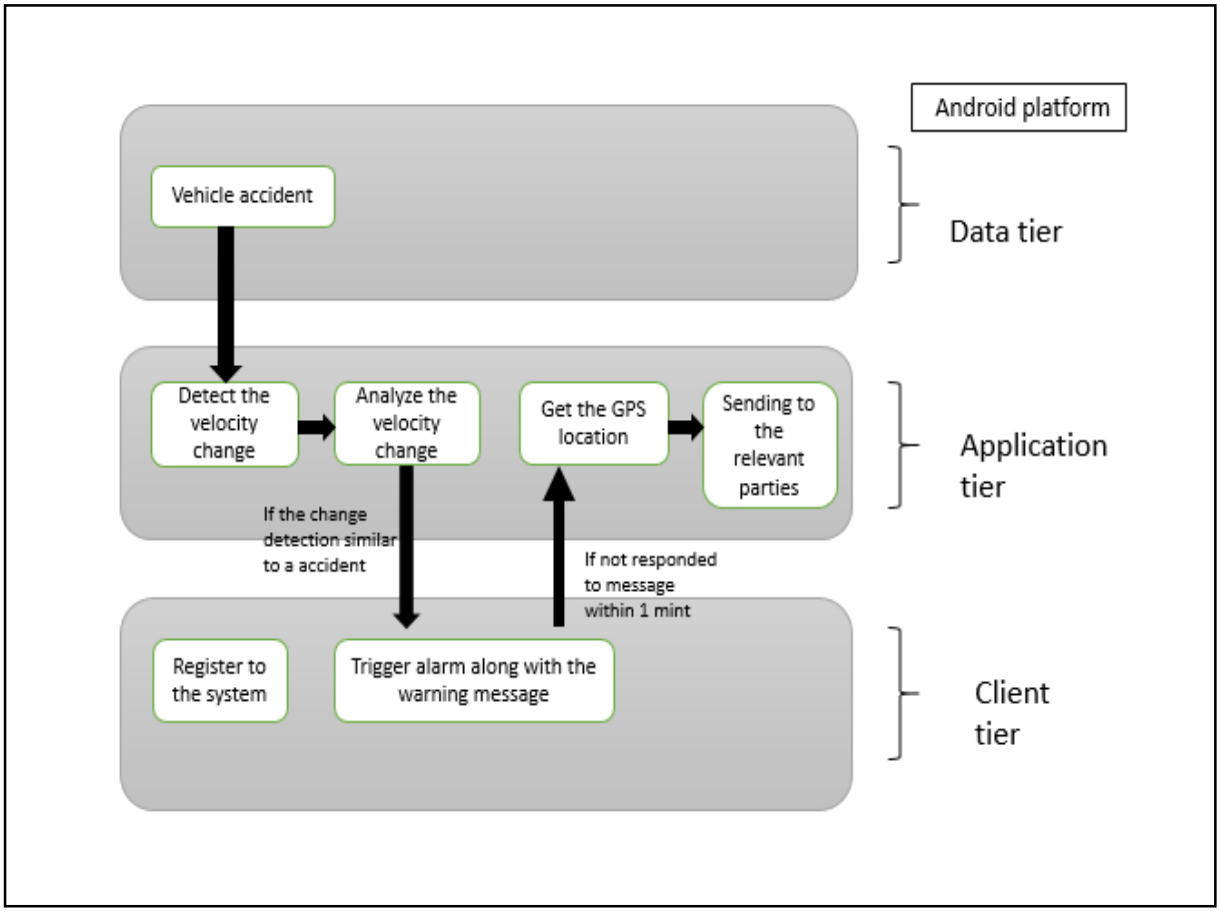

Figure 19 - High level architecture of the proposed system

This is the designed High level Architecture for the proposed system. As you can see it modelled using three tier concept. Data tier, application tier, client tier are the three stages of the three tier concept. If we use this three tier architecture, it is ensure that the maintainability and increase of performances can be increase.

5.3.2.1 Data tier

This data tier component contains all the data that needed for the composed system. In my solution main input data is the velocity change. Therefore if an accident or a non-accident without harm happens that change take as the data for the system.

5.3.2.2 Application tier

This component is the main and important part of the proposed system. All the logical evaluation are done within this component. Basically all the tiers are depend on this tier. Here when an accident happens the required data analysing here. After detect the velocity change within this tier it evaluating. After evaluating system deciding whether it is an accident or not. If the change similar to an accident coordinates it trigger an alarm along with a warning message. If the user didn't respond to the message within 1 minute system detecting it is as an accident. These tasks are belongs to client tier because it's done by user. Then system get the GPS location and sending to relevant parties. This tier has the technical process of the system mainly.

5.3.2.3 Client tier

This tier has the ability of interacting with the end users for deliver the final stage of the proposed system. In this stage user has the features of register to the system, view the previously added data and update the details. When system detect an accident warning message displaying.

5.4 Low level design

In the low level design main output is outline the relationships between classes and functions In order to meet the expecting results. Here we use the class diagram, sequence diagram and the context diagram for deliver the low level design for the solution.

5.4.1 Class diagram

In order to describe the structure of the system author used the class diagram. It helps me to reach the desired goals for implement the proposed solution. Author has listed down the classes in a table to give a description about them

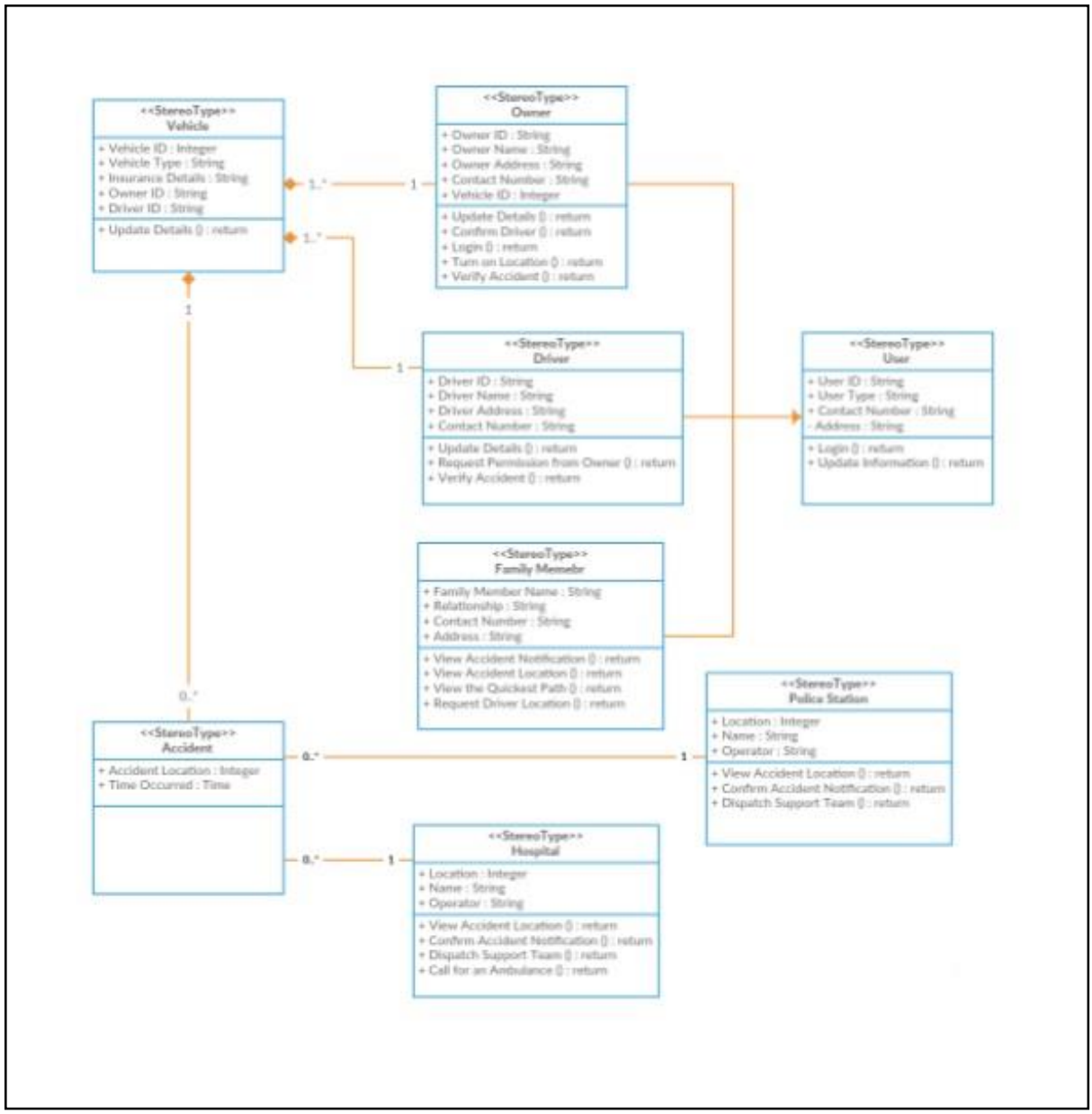

Figure 20 - High level architecture of the proposed system

Class	Description
Accident	This class is contain with the accident details. Through this class required data will be send.
Hospital	Hospital class handle when an accident report received to hospital. Then send the relevant rescue team

Police	Police class handle when an accident report received to police. Then send the relevant rescue team
Family member	Relation class is the people who gets the messages when accident happens as the relation of the victim
User	User is the end user of this product
Driver	This class contains extra details of the user.
owner	This class contains extra details of the user. Owner can be the user.

Table 16 - Description of identified classes

5.4.2 Sequence diagram

Sequence diagram's main purpose is graphically represent the logical flow of the proposed system. It outline the relations and communications between the classes of the proposed system in sequential order. Author created the sequence diagrams for figure out using use cases to see the interactions between classes. Here the author represent the sequence diagram below.

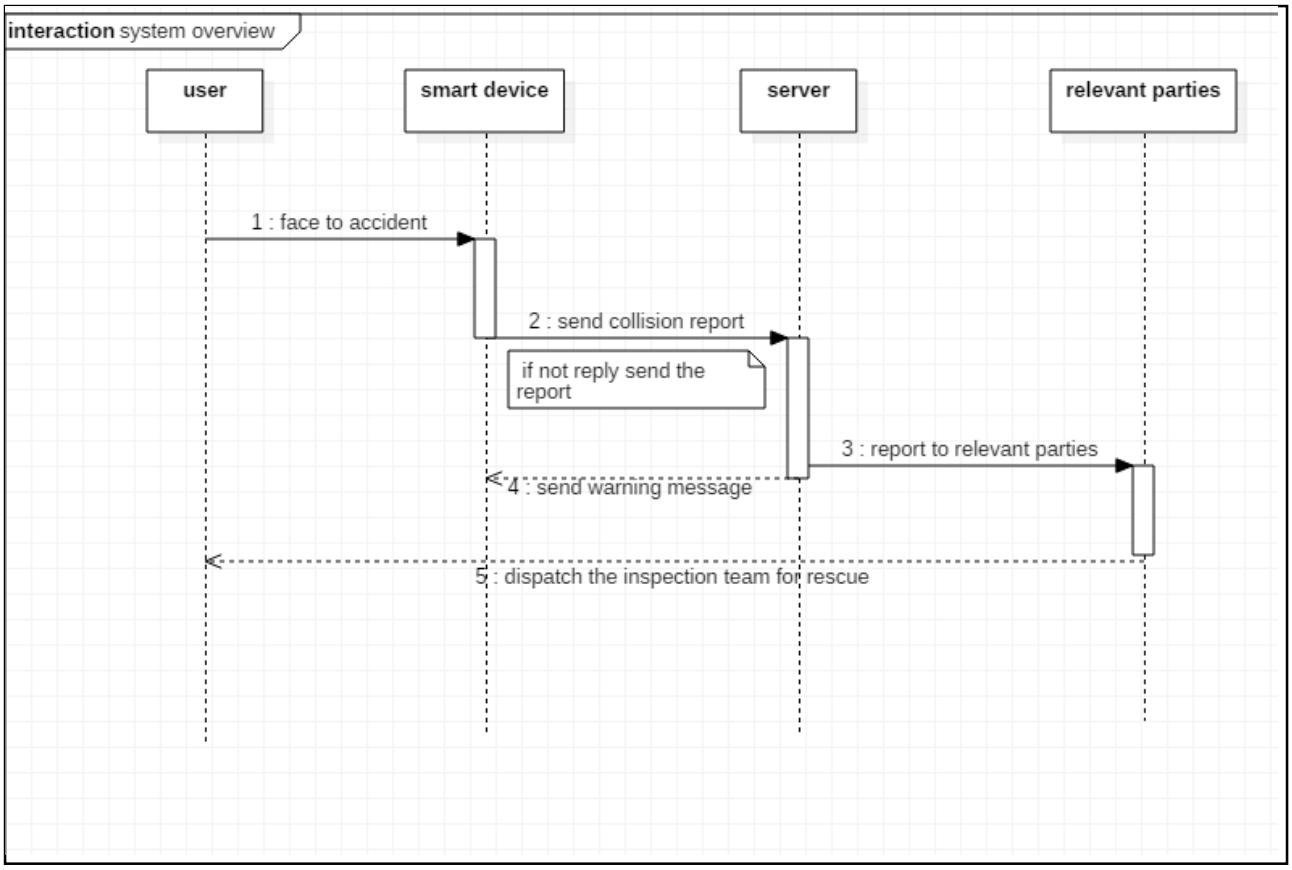

Figure 21 - sequence diagram for the proposed solution

Since mainly proposed system having a one activity author modelled one sequence diagram. Author declared 4 lifeline namely user, smart device, server and relevant authorities. These four are the main lifeline of the system. When a user face to an accident smart device detecting that and take the velocity change and generate a warning message itself. Those two activities are happening within two life lines. Within smart device many processing are happens. In order to generate the relevant details smart device get the GPS location and nature of the accident. Smart device detect an accident and then triggering an alarm itself in the smart device. It is the warning alarm which asking form the drive or any passengers in the vehicle. Warning message asking “you are having one minute to reply message” Like a question. if the user fail to reply for the warning within 1 minute smart device send message to the relevant parties through the server. After relevant parties receiving the details they taking actions for the incident. As you can see sequence diagram helps to reveal the logical data flow of the proposed system. Each and every stages can draw here as the lifelines. It helps to design the data flow easily. Therefore the inter communication of the classes can figure out here.

5.4.3 Context diagram

The context diagram represent the visual flow of the information that sharing within the proposed solution. This helps to figure out how the information entering to the system and leaves the system in the proposed system. Also data storing and the changes that happening to the information can be understand through this. By designing context diagram system of the desired scope and the boundaries of the system can figure out easily.

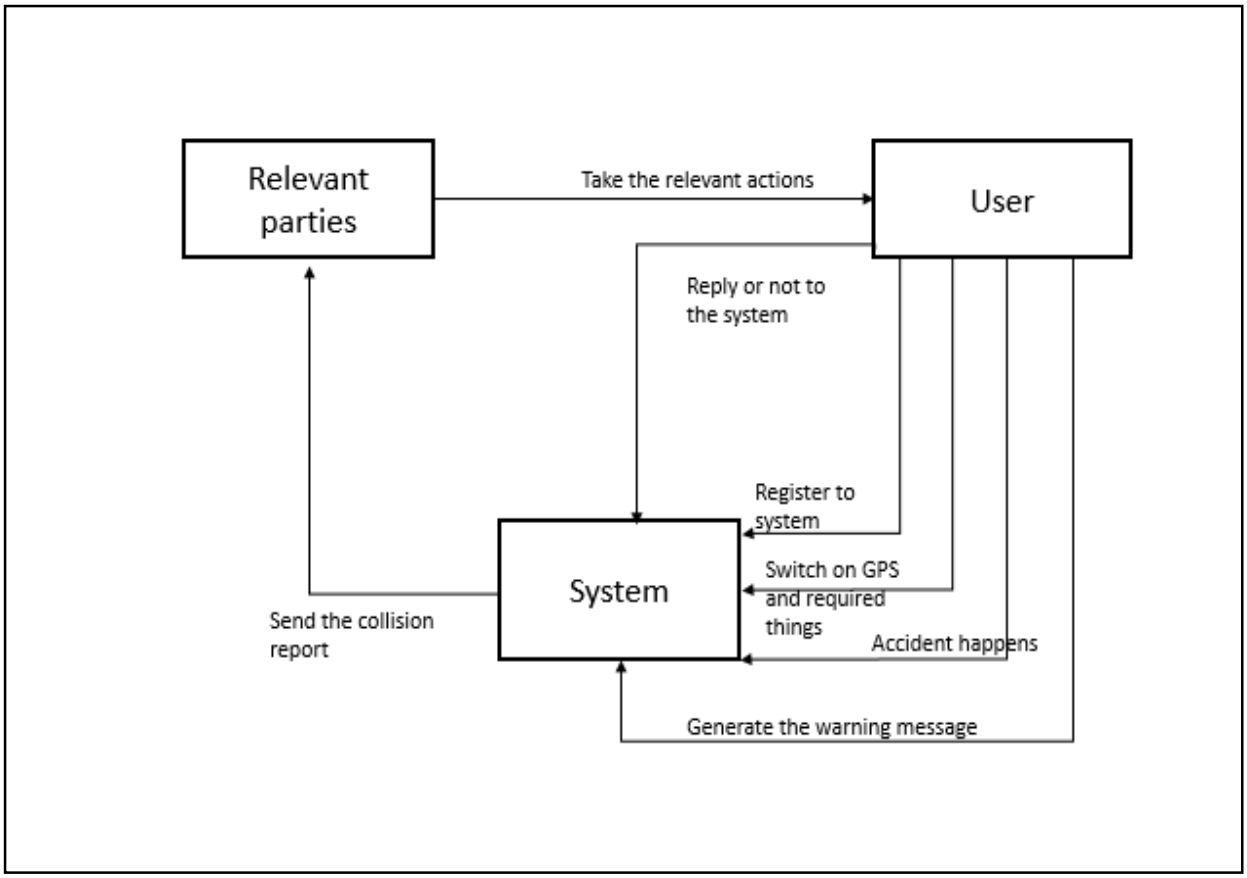

Figure 22 - context diagram for the proposed system

First of all user has to register into the system. The user facing to accident or an accident without any harms. Then the system detecting the velocity change and trigger an alarm by sending a warning message to the user. If the user reply for the message within one minute relevant processes happening but if the user didn't respond to the message within 1 minute there is a report generating along with the GPS location. Thorough a GSM message system distributing messages to the relevant authorities like police, hospital and relative. Then the relevant parties taking relevant action for rescue the victim.

5.5 design wire frames

Here are few wire frames of the system.

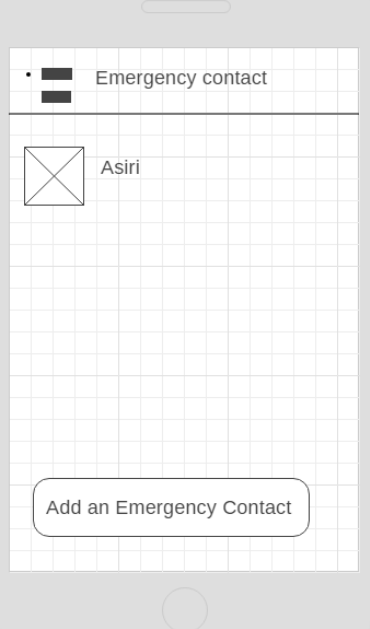

Figure 23 - emergency contact add mock up

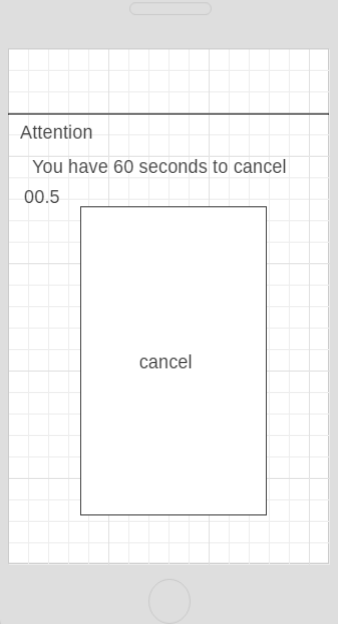

Figure 24 - Warning message display

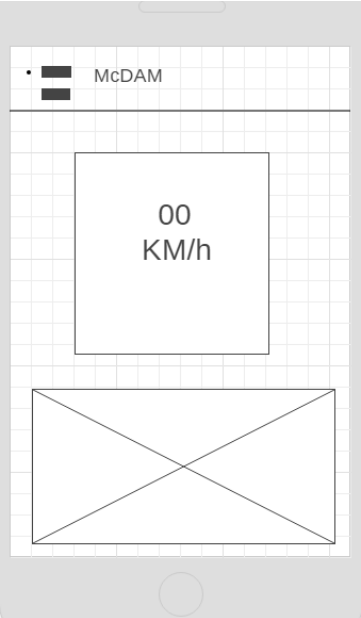

Figure 25 - vehicle speed mock up

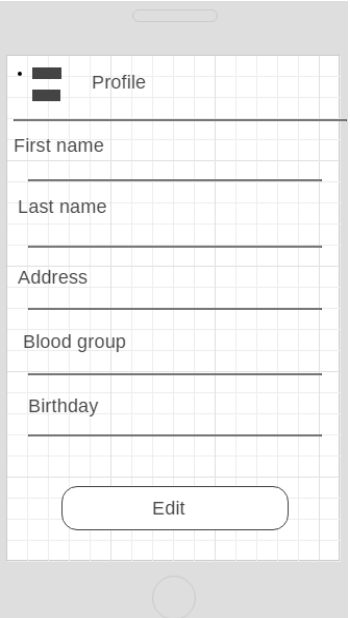

Figure 26 - profile details and edit mock up

5.6 Chapter summary

Initially this chapter described the both high level and low level architecture of the system for the proposed solution. High level architecture defines the system in details and outlined the overall system clearly. The low level architecture demonstrated using OOP graphical models such as class diagram, sequence diagram and context diagram. For each and every diagram description was defined and UI mock-ups had been provided.

The next chapter will focusing the implementation of prototype and discuss the functions of the prototype and tools of the proposed solution.

Chapter 6 – implementation

6.1 chapter overview

The previous chapter provided the details of design and architecture of the proposed system. It reveals the design of the system by using high level and low level architecture. In order to design the system there use class diagram, sequence diagram, rich picture, context diagram.

This chapter will focus on the implementation phase of the proposed solution. Firstly chapter will discuss about the suitable programming languages for implementation. After that used IDE will describe. The coding standards will briefly explain. External libraries and technologies that we used will explain. Features of the proposed solution will explain using code snippets and UI mock-ups.

6.2 Selection of technologies

The proposed solution of Motion collision Detector for Automobiles is a native mobile application. It implemented using Android operating system. Natives applications are developing for particular platform using a device. Native applications has good reliability than cross platform applications.

To create a high performance native application, after a technology evaluation selected the technologies in order to implement the proposed solution.

6.3 selection of tools

The proposed solution implemented using android and java. Main IDE that used is Android studio. Android studio mainly developed to create Android application. Android application can Implemented using java and C#. XML used in the implementing the UI phase. Referring the research papers author figure out that best programming language to implement this system is java. Google also proving that.

6.4 Coding standards

Throughout the implementation stage coding standards were used to develop the system. The importance of coding standards was maintainability and easy to debug the system. If a system used the code standards, the quality of the system is high. In this coding standards phase variable naming, method naming, class naming were mainly focused. Commenting also another important side in the coding standards.

6.4.1 Variable and method naming

All methods and variables were named under camel case style. It follows the javadoc standard variable naming and method naming conventions.

6.4.3 Class naming

Class names in java and android begin with the upper case. According the javadoc standards were followed.

6.4.4 Comments

Since the main programming language is android, android commenting standards were followed.

6.6 Technologies and External libraries

Few technologies and external libraries was used to implement the proposed system. They are listed below

1. GPS technology

   The definition of GPS is global positioning system. It is a global navigation system which is used to gather details about mainly accurate locations and timing services. System using this technology in order to get the location of the victim and detect the accident. It is a free technology that available for use to unlimited users anywhere in the world. By the revolution of the mobile industry, fully functional GPS receivers incorporated with the mobile phones. Therefore it was be easy to use this technology into this system.

2. Google map API

   Google map is a web map system which is invented by google in 2005. It provide many features such as street maps,360 panoramic view of streets, satellite imagery, real time traffic situations and route planning for travelling by foot, vehicle or bus. Google maps offering an API which allows map into the third party systems.

   In this system google maps using to send a graphical view of the accident place and see the place where the vehicle is positioned.

3. Accelerometer

   The accelerometer is a device that use to measure the acceleration of any kind of object. Basically accelerometer measure the acceleration due to earth gravity straight upwards (by definition) of $g \approx 9.81\ m/s^{2\cdot}$ (james . 2010).

   In this system accelerometer used to detect an accident according to acceleration change of the vehicle. As the author mentioned revolution of smart phone industry, accelerometer also coming as an inbuilt option in the smartphone. Therefore proposed system can use the accelerometer device since it is a software based android application.

6.7 Features of prototype

Following phase examines the features of prototype and describe how the implementation is carried out. By providing code snippets and screen shots of the feature it will describe properly.

6.7.1 Detect the accident

According to the functional requirement list this is the main function of this proposed solution. When an accident happens it detect changes and evaluating it. For detect the accident, system getting velocity change and accelerometer motion.

- Code snippet for accelerometer motion detection

```
if (event.sensor.getType() == Sensor.TYPE_ACCELEROMETER){

    // alpha is calculated as t / (t + dT)
        // with t, the low-pass filter's time-constant
        // and dT, the event delivery rate
        float alpha = (float)0.8;
        gravity[0] = alpha * gravity[0] + (1 - alpha) * event.values[0];
        gravity[1] = alpha * gravity[1] + (1 - alpha) * event.values[1];
        gravity[2] = alpha * gravity[2] + (1 - alpha) * event.values[2];
        event.values[0] = event.values[0] - gravity[0];
        event.values[1] = event.values[1] - gravity[1];
        event.values[2] = event.values[2] - gravity[2];

        //If accelerometer data
        calculChoc(Math.abs(event.values[0]) + Math.abs(event.values[1]) + Math.abs(event.values[2]));
}else if (event.sensor.getType() == Sensor.TYPE_GYROSCOPE){
    //If gyro data
```

Figure 27 - code snippet for accelerometer motion detection

This is the code which I used to detect the accelerometer‘s motion change. In order to detect the accident system required two main inputs and this function is one of them. The velocity change measuring using this function. It measuring three axis values in order to get the values. Then it deliver a measured value to system for check the situation.

- Code snippet for GPS change

```
@Override
public void onLocationChanged(Location location) {
    timeLastLocationData = (int)(System.currentTimeMillis()/1000);
    speed[currentSpeed] = location.getSpeed() * (float) 3.6;
    gpsCallBack.onSpeedRecieved(speed[currentSpeed]);

    if (currentSpeed < 2) {
        currentSpeed++;
    }else{
        currentSpeed = 0;
    }
}
```

Figure 28 - code snippet for gather the GPS values

Through this function system measure the gravity change of the mobile. That means vehicle's GPS location change. After getting that value, system combining those two values that gathering from accelerometer also and system executing a calculation.

After getting those two values system doing a calculation using following code.

```
float AccidentProba = 0;
AccidentProba = pwr/2;

//Che seeks a decrease in speed and the average speed in t
float chocDif = 0;
float vitmoy = 0;
for(int i = 0; i < 2; i++){
    vitmoy += speed[i];
    float tmpChocDif = speed[i+1] - speed[i];
    if (tmpChocDif < 0) {
        if (tmpChocDif < chocDif) {
            chocDif = tmpChocDif;
        }
    }
}
```

Figure 29 - calculation function

After doing the calculation, the output value going to check using the algorithm.

```
Random rand = new Random();
int n = rand.nextInt(3) - 1;
egg.setRotation(n * AccidentProba * 5);

/** User got an accident */
if (AccidentProba > 9 ) {
    isCrack = true;
    egg.setImageResource(R.drawable.newcrack);

    try {
        Vibrator v = (Vibrator) getContext().getSystemService(getContext().VIBRATOR_SERVICE)
        v.vibrate(500);
    }catch (Exception e){
        Log.d("error", "Error");
    }
```

Figure 30 - evaluating the calculated value

This code evaluating the change that detected whether it is an accident or not.

Figure 31 - warning message UI

6.7.2 Detect the vehicle speed

For detect the vehicle speed following function will be used.

```
@Override
public void onLocationChanged(Location location) {
    if (location==null){
        percentage.setText("--");
    }else {
        float speed = location.getSpeed();
        percentage.setText(String.valueOf( Math.round(speed*3.6)));
        lat=location.getLatitude();
        lon=location.getLongitude();
    }
}
```

Figure : code snippet for measure the vehicle speed

Using this code, current speed of the vehicle will be display in the application.

Figure 32 - vehicle speed UI

6.7.3 Get the location from google maps

In order to see the current position, the same function in the Figure 28 will be use.

Figure 33 - location detecting UI

6.7.4 Add the emergency contacts

In order to send the collision report user must add emergency contact into the application. Following function used to implement that requirement.

To get the numbers from phone book this function used.

```
if (convertView == null) {
    // inflate the layout
    LayoutInflater inflater = ((Activity) parent.getContext()).getLayoutInflater();
    convertView = inflater.inflate(R.layout.listview_contact_added, parent, false);

    // well set up the ViewHolder
    viewHolder = new ContactViewHolder();
    viewHolder.name = (TextView) convertView.findViewById(R.id.nameContactAdded);
    viewHolder.icon = (ImageView) convertView.findViewById(R.id.corbeille);

    // store the holder with the view.
    convertView.setTag(viewHolder);

} else {
    viewHolder = (ContactViewHolder) convertView.getTag();
}
```

```
if (contact != null) {
    viewHolder.name.setText(contact);
    viewHolder.icon.setBackgroundColor(ContextCompat.getColor(parent.getContext(),R.color.colorPrimaryDark));
    viewHolder.icon.setOnClickListener((view) -> {
            /** Deleting the emergency user selected from the bdd*/
            ActionEmergencyContactHelper actionEmergencyContactHelper = new ActionEmergencyContactHelper(parent.getContext());
            actionEmergencyContactHelper.deletingEmergencyContact(getItem(position).toString());

            /** Removing the user from the ArrayList */
            mData.remove(position);
            notifyDataSetChanged();
    });
}
```

Figure 34 - add emergency contacts

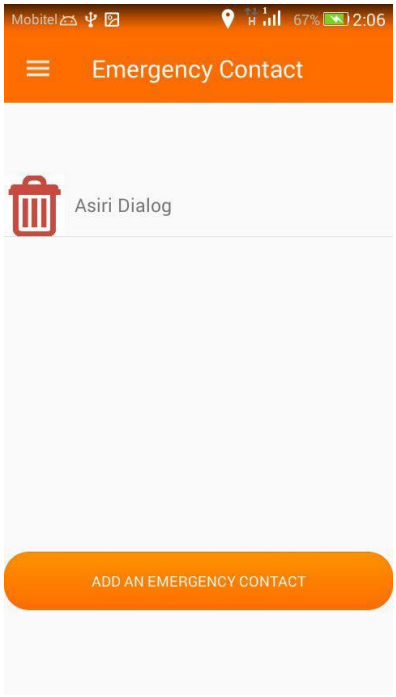

Figure 35 - emergency contact adding UI

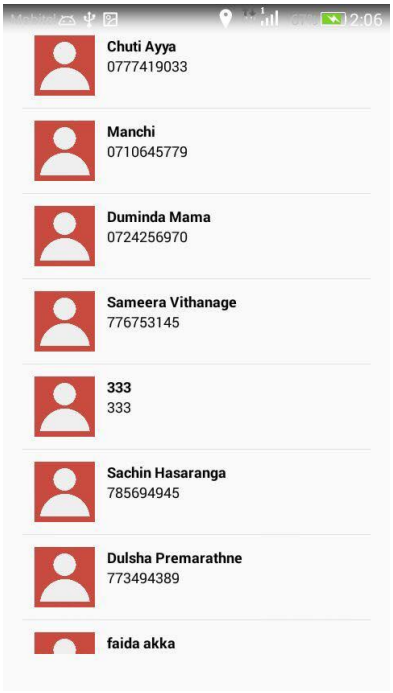

Figure 36 - emergency contact adding UI

6.7 Chapter summary

This chapter discussed the feature implementation process of Motion collision Detector for Automobiles. Then it described the selection of technologies in order to implement the application. Used IDE and the reason for select that IDE is discussed there. After that coding standards used and the external libraries and technologies were described. The key functions of the prototype were described using implemented code snippets and UI's of the prototype. The next chapter will discuss about the testing phase of the proposed solution.

Chapter 07 – Testing

7.1 Chapter overview

The previous chapter discussed about the implantation phase of the Motion Collision Detector for automobile (McDAM) project. The used technologies and tools are described there.

This chapter will focusing on the testing plan of the implemented prototype. First of all it will discuss the aim and objectives of the testing stage and it will discuss testing criteria of the implemented system. Then this chapter will describe the functional and non-functional requirement of the prototype in order to check whether it meet the relevant and required requirements. At last it will provide a description about the limitations encountered in the testing process.

7.2 Aim and objectives of the Testing

Testing stage was used to verify that the implemented prototype functions are working properly and meet the desired output from the prototype. Objectives for in order to test the implemented prototype are listed below.

- Verification of the functional requirements of proposed solution
- Verification of the non-functional requirements of proposed solution
- Figure out the errors in the product in order to fix them before deliver the final product
- Improve the features of the system based on test results

7.3 Testing criteria

Testing criteria can be divide into 3 stages as mentioned below.

1. First stage :- functional quality of the system
   Verify the functional requirements of the system and figure out the flow of the system, defects and performance.
2. Second stage:- structural quality of the system
   Check the maintainability and reusability and measure the efficiency of the code.
3. Third stage :- process quality of the system

Delivering the proposed product while meeting the constraints like cost, time and resources. Chappell (2012)

"In software testing involves, approximately 50% of the elapsed time and over 50% of the

Total cost" (Myers, 1979). From this quote we can figure out testing is very important thing in software life cycle.

The testing phase is consist with different types of testing methods. Unit testing, Module testing, Integration testing, Sub-system testing are some of those testing types. In this prototype I used module testing and integration testing. Also verify the both functional and non-functional requirements used functional and non-functional testing. All the testing followed the test plan. Quality of the software can verify from two sides.

1. Functional quality
2. Non-functional quality

7.4 Functional testing

Here functional requirements tested by using the type of functional testing. Since functional requirements are the core features of a system it is very important to test them correctly. If somehow we deliver the product without tested correctly, the entire impression about the system will be lost.

ID	Requirement	Priority	Implantation stage	Test status
FR1	Create account	High	implemented	Tested
FR2	Login to the system	High	implemented	Tested
FR3	Update details	Medium	implemented	Tested
FR4	Detect the accident	High	implemented	Tested
FR5	Get the GPS locations of accident place	High	implemented	Tested
FR6	Add the emergency contacts	High	implemented	Tested
FR7	Send the report to relevant parties	High	implemented	Tested

Table 17 - Functional requirements testing

7.5 Module testing

By using this testing method some functional requirement tested.

7.5.1 Detect the accident module

Detecting the accident is the core function of this system. It should detect the accident properly. In this module testing, this function tested. By attaching the mobile into a toy car we tested it (can't test it as a real world situation, since we can't use real vehicle and test it). Giving sudden motion for the mobile phone we tested the system.

7.5.2 Location detection module

In order to get the correct details of the location Through the GPS system should take the correct location. Author tested it multiple time by going many places. System retrieve the correct location details every time the system tested.

7.5.3 Message sending module

Another key module of this system is sending the collision report (as a GSM message) to relevant parties. When an accident happens system after evaluating and if it is an accident system generate a message. So that message should be send to relevant parties. So Author tested it multiple times by giving a sudden motion to mobile and didn't reply to the message within 1 minute. Then the message generated and sent to the emergency contacts.

7.6 Integration Testing

By combining all the modules of detect accident module, location detection module, message sending module integration testing was done. And author tested the combination and data flow of the system by this testing method. Another thing is integration testing can be perform from the system level or unit level.

7.7 Non-functional testing

Non-functional requirements are another important requirement set. In the system requirement specification, all the non-functional requirements are specified. Non-functional requirements reveals the quality of the system.

7.7.1 Accuracy testing

One of the major non-functional requirement of this system is accuracy. Tested accuracy level by doing multiple testing and ended up with around 80% of accuracy level.

7.7.2 Performance testing

The performance testing was done by according to the time that system takes to perform the functional requirements. Summary of the performance testing is listed down in the following table. In order to test the performance

No	Task	Input data	Output expected	Time spent (seconds)	Pass rate	status
01	Detect the accident	Give a sudden motion	Trigger the alarm within 2 seconds	2	8/10	80%
02	Get the GPS location correctly	Given the motion multiple times by going few places.	Take the location of the mobile phone	1 (in here we tested location detect performance also)	9/10	90%
03	Send the message	Did not reply to warning message	Send the message to emergency contacts	5 seconds (this also depend on the GSM connection)	10/10	100%

Table 18 - Performance testing of performance

7.8 Power consumption

Tested the power consumption of the Motion Collision Detector for Automobiles (McDAM) project in Huawei nova2i phone. In order to check the power consumption author used Accubattery pro application.

The system was run for 10 minutes and measure the consumption using joule (J) And compared with some other GPS required applications power consumptions. Comparison ended up with these values.

Application	Tested time (run time)	Tested mobile	Power consumption
Ingress	10 minutes	Huawei nova 2i	80j
pokemonGo	10 minutes	Huawei nova 2i	100j
Resources	10 minutes	Huawei nova 2i	90j
McDAM	10 minutes	Huawei nova 2i	120j

Table 19 - power comparison of GPS required applications

After the power consumption comparison it reveals that McDAM application having high value compare to other application.

Throughout the journey implemented application should run. So the battery power is not enough for that. As a solution users can plug it into the power output of the vehicle. Then the power consumption of the mobile is not becoming a big issue.

7.9 Test results

After doing the module testing, functional testing and non-functional testing, gathered summery about the implemented application.

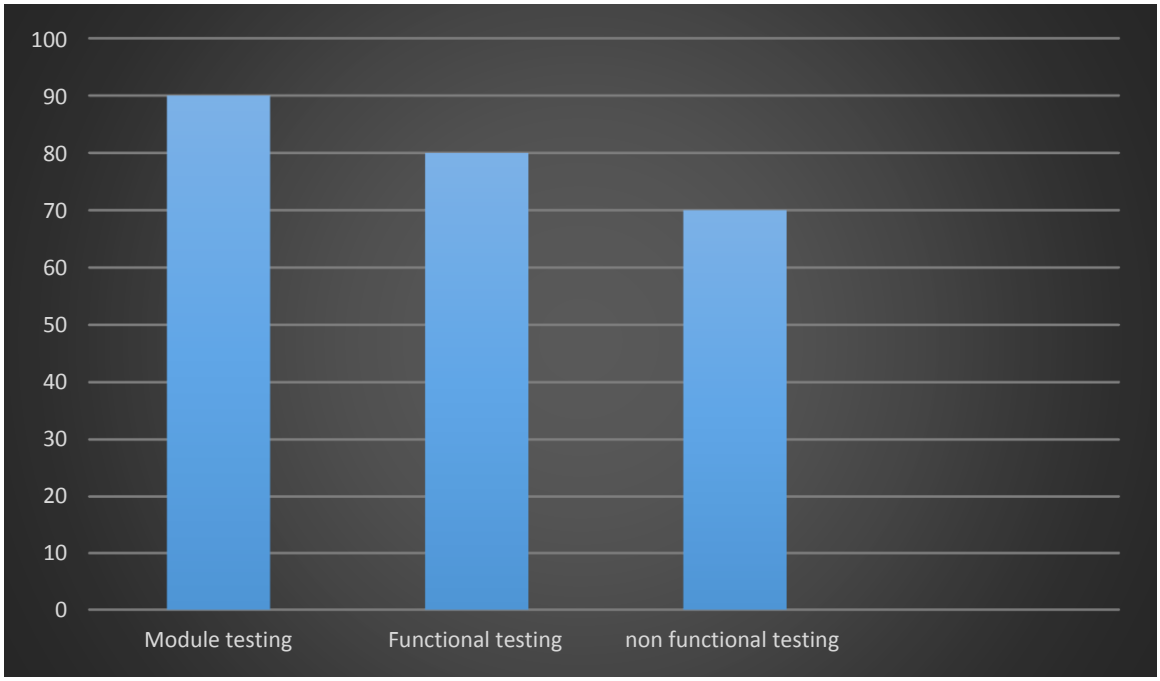

Figure 37 - Testing summary

7.10 Chapter summary

The chapter initially discussed the goals and objectives of the testing. Under testing criteria the three testing criteria was described. Another testing methods mentioned there. In the functional testing section tested the functional features of the system. Module testing was done in the next section. All the module which identified tested using that method. Integration testing also mentioned there. Non-functional requirements under the Non-functional testing. Accuracy and performances verified under that method. Since this is a mobile application power comparison was done by comparing few other application. After all the testing and testing summary was discussed.

The next chapter will explain the critical evaluation for the implemented solution.

8.0 Chapter 08 – Evaluation

8.1 Chapter overview

The previous chapter testing chapter focused the testing criteria of the Motion Collision Detector for Automobile solution. This chapter mainly describe the evaluation process of the proposed solution. Evaluations gathered from the evaluators by giving the introduction of the project and doing questionnaires. Evaluation methodologies which I used to evaluate the system critically described here. Moreover discuss the contribution of course modules and external learning which used in the proposed solution.

8.2 Evaluation criteria

The proposed solution evaluated using the following evaluation criteria's.

criteria	Reason to evaluate
Overall concept	To gather the opinions and comments for the overall concepts of the project and critically evaluate the concept.
Scope of the project	To gather the ideas and feedbacks from the experts on the project scope
System design and architecture	To make sure that proposed solution provide a better solution and assess the design methodologies and architecture as expected.
prototype	to evaluate the prototype delivering the expected concept of the proposed system
Accuracy and performances	To evaluate the proposed system's nonfunctional requirements are achieved successfully.
limitations	Identify the limitations of the solution
Future enhancements	To gather the enhancements that can be attach to the current system to improve the outcome of the project

Table 20 - evaluation criteria's

8.3 Evaluators

The evaluation was done with the meeting the two groups of evaluators.

1. Experts in the proposed solution area

   Evaluation performed by interacting with electronic engineers, software engineers, system architecture designers and people who are related to the proposed solution area.
2. End users

   Evaluation performed by interacting with few end user of this proposed solution such as people who are travelling most of the time.

8.3.1 Selected evaluators

Following evaluators were selected to perform the evaluation.

Name	profession	experience
Mr. thilina madumal	Software engineer	6 years of experience in software field
Mr. rajitha hathurusinghe	Electronic engineer	5 years in electronic field
Mr. sepala hattotuwa	Automobile expert (end user)	30 years of experience

Table 21 - selected evaluators

Other than these evaluators, author performed few informal evaluation using people who are related to the proposed solution area.

8.4 Evaluation methodology

In order to perform the evaluation a used interviews and questionnaires. Interviews done with industrial employees and expert related to the project area. According to time constraints sometimes evaluations performed using questionnaires. The evaluation performed using both qualitative and quantitative methodologies.

8.5 feedback received from the evaluators

The evaluation feedback which received from the evaluated according to the mentioned criteria summarized below.

8.5.1 Overall concept

“Today mobile application solutions are highly expanded area and it is so reliable to use. It is giving the easiness from a complex problems. I think this solution will do a huge impact on automobile collision area “– Mr. rajitha hathurusinghe (electronic engineer)

“This solution will be easily detect an accident and take the required actions immediately” – Mr. thilina madumal (software engineer)

“I think this project will make a difference in automobile industry” – Mr. sepala hattotuwa (automobile expert)

“This project concept is so effective. I think through this solution we can save many lives” – Ms.hiruni Lenora (IT teacher)

Summary of feedback:-

Evaluators were satisfied with the proposed solution. The selected platform to implement the solution is so effective for a problem like this. Through this solution, can make a big impact into the society.

Other than that they were satisfied with feature which I implemented in the solution.

8.5.2 Scope of the project

“Scope of the project is sufficient for an undergraduate. Since it is a mobile application it provides the features same as a hardware solution features” – Mr. rajitha hathurusinghe (electronic engineer)

“I appreciate the scope of the project because in a world with a growing of IOT devices, from this scope can deliver an application with a good accuracy” - Mr. thilina madumal (software engineer)

“I think from this project scope, can solve the one of the huge problem in automobile industry”- Mr. sepala hattotuwa (automobile expert)

“When looking at the project scope, it is a good attempt from a undergraduate to implement a solution like this” – Ms.hiruni Lenora (IT teacher)

Summary of feedback: -

Evaluators are having a good expectations on the scope of the project. However according to the feedback they appreciate to select a project like this

8.5.3 System design and architecture

"Modelling the concept and components using 3 tier as the high level architecture of the prototype has given a critical contribution to the implementation" - Mr. thilina madumal (software engineer)

"Considering the technologies selected, using IOT concepts and the used algorithms improved the accuracy of the application. - – Mr. rajitha hathurusinghe (electronic engineer)

Summary of feedback:-

They were happy with the technologies I used and the concepts and algorithms which I used. They were satisfied with the high level and low level architecture techniques. As a summary of their feedback the all the methodologies used are made the huge impact in order to implement a system with a huge accuracy.

8.5.4 Prototype

"Prototype addressing the problem identified. From outcomes of the prototype are clearly acceptable. The feature are working properly in order to provide the expected solution" - Mr. thilina madumal (software engineer)

"It is very easy to use this prototype. Since nowadays almost all the people are using smart phones, through this project it is so easy to use this application" - Mr. sepala hattotuwa (automobile expert)

"Provided prototype is so reliable. The usability of the prototype is acceptable" - Mr. rajitha hathurusinghe (electronic engineer)

Summary of the feedback:-

Evaluators stated that the prototype addressing the expected solution. They were happy with the features of the solution stated that the feature implemented properly.

8.5.5 Accuracy and performances

"Motion detection method has a good accuracy and the GPS locations are which generating has the accurate coordinates" - Mr. thilina madumal (software engineer)

"Outcomes of this project consist with high percentage of accuracy. The performances has an acceptable percentage" - Mr. rajitha hathurusinghe (electronic engineer)

"In my 30 years of automobile carreer I have never used a system like this. But the features of this solution has a good accuracy. The GPS location and the way of detecting velocity change has a good performance. - Mr. sepala hattotuwa (automobile expert)

Summary of feedback:-

Evaluators were satisfied with the accuracy and performances of the system. As they mention the way of detecting the collision has a good percentage.

8.5.6 Limitations and future enhancements

"If the solution can provide the whole travelling path of the victim, it is good to figure out the collision are easily." - Mr. thilina madumal (software engineer)

"These days android and ios mobiles are the most using mobiles. It is good to implement a system from the ios platform also" - Mr. rajitha hathurusinghe (electronic engineer)

Summary of feedback:-

Evaluators outlined few limitations and future enhancements to improve my system by providing valuable ideas.

8.6 Self evaluation

Self-evaluation according to the given criteria is described below.

8.6.1 Overall concept

Selecting the most appropriate software for a requirements is a difficult task. This attempt can be considered as a valid solution for this problem. In addition, this solution can be expanded in other domains to provide a complete solution with a business layer.

8.6.2 Scope of the project

This project basically consist with the IOT concepts and some areas related to automobile industry. Scope of the project is satisfied.

8.6.3 System design and architecture

For designing the system and architecture, used methodologies are selected by referring many research papers related to the system design and architecture. So I could able to do the implementation easily from these designing. The technologies, platforms which I used for the implementation, selected after a critical evaluation. So the system design and implementations meet the standards of a good system.

8.6.4 Prototype

Prototype provides the expected solution for the proposed system of Motion Collision Detector for Automobiles.

8.6.5 Accuracy and performances

Implemented system's functional and non-functional requirements having a high percentage of accuracy. The details collected from the testing proves that statement. Performance also in a high level.

8.6.7 Limitations and future enhancements

Limitations were figure out from the expert evaluations and also gathered few future enhancement in order to implement a system with more features.

8.7 Chapter summary

This chapter reveals the selected evaluation criteria and purposes to select those criteria. Then the select evaluators and their details provided. Interviews and questionnaires used to evaluate the proposed solution. Using the evaluators evaluate the system according to criteria. For the most of the functions I got positive feedbacks. As a summary of the evaluation overall system having a high level of accuracy. The detailed description of self-evaluation carried out about the system using evaluation criteria.

The next chapter will define the results, achievements and improvements of the project.

Chapter 9 – Conclusion

9.1 chapter overview

The previous chapter was discussed the evaluation criteria of the proposed system. This chapter will outline the conclusion of proposed system's design, development and evaluation of the project. Problems and challenges faced in various stages of the implementation along with the limitations of the proposed solution will be discuss here. The learning outcomes of the proposed system and future enhancements which we figure out will be discuss here. Finally this chapter will outline a reflection of the project.

9.2 Achievement of Aims and objects

Aim

"Project aim is to research, design, implement and evaluate a mobile application to reduce the death amount of the people from the motor vehicle accidents by informing immediately to the relevant authorities"

Proposed Motion Collision Detector for Automobiles (McDAM) project was able to achieve the aim of it within the time period which given. By evaluating and testing author figured out that this project achieve its aim successfully.

Completed objectives

- Did the researches related to the research areas and found the existing projects which related to proposed idea. By referring those projects and researches figure out the limitations on proposed idea. By summarizing those research details prepared the TOR with including aim, objectives along with project outcomes, problem domain and resource requirement and the activity schedule. Chapter 1 contains all the details which included in the TOR.
- Literature review of the system discuss the background of the problem domain using research details. By analysing existing projects and related research ideas gathered the limitations. The techniques to include into the system was analyzed from the literature review. Chapter 2 contains the all the details of LR.
- Requirement gathering was done by using few techniques. Literature review, interviews, online surveys and self-evaluations used to gather the proper functional and non-functional requirement in order to implement the system.

- After the requirement elicitation, decided the suitable functional and non-functional requirements.
- Software requirement specification prepared using the selected requirements. Chapter 4 contains the details of the requirement gathering.
- After gathering details about technologies, techniques, tools and libraries implementation stage was started according to the time schedule.
- Each and every qualitative and quantitative facts were tested using a test plan. Details related to the testing included in the chapter 7.
- The evaluation stage was performed by using domain experts and end users of the system. The feedback was received used to improve the system and increase the accuracy and performances.
- As the last stage documenting all the details were started. Final thesis is preparing into a standard level using the knowledge gathered from the research papers.

9.3 Existing knowledge used to implementation

- The knowledge we gathered since 1st year about modelling techniques such as UML and other techniques prepare the design and the structure of the system.
- The knowledge initially gathered from 2nd year about android, java, and some techniques used to implement the system.

9.4 Learning outcomes

This project improved my knowledge of many technical and soft skills. Some of are listed and described below. The knowledge that gathered from the module of this degree program was not be sufficient in order to implement this system but thanks to the lecturers of university author made first step to start this project. Therefore I had to learn many implementation related stuffs.

- Selecting proper and suitable research papers, eBooks, articles and magazine.
- Interacting with domain experts and gather the knowledge from them properly.
- More knowledge on programming languages such as android , java and research areas like IOT , machine learning , mobile research areas
- Soft skills of problem solving, time management and critical analysing
- Technique to evaluate system using qualitative and quantitative aspects
- Gain the knowledge of project management
- Work under pressure is one of major skill I gathered by doing this project

- Report writing skills according to the standards(ex: inline citations)

9.5 Problems and challenges

During the project implementation stage, documentation stage and overall throughout the whole stages of this project, several problems and challenges were encountered. They are listed below

- Time constraint

  For this research project there was limited time to do all the documentations and implement the application. Failure of understand the suitable requirement time was be limited. To avoid those time failures many techniques was used.

- Lack of experience in techniques and technologies

  For this project many technologies and techniques were required. Some of them even did not here. To avoid this challenge did the self-study and research.

- Requirement gathering from domain experts

  While requirement gathering with the domain experts there were many problems encountered. Because of the time constraints of the experts many problem encountered in requirement gathering.

- Documenting

  Documenting is not much easier than expect. Because of the lack of experiences in documenting and high level language requirement documenting was be bit hard to implement.

9.6 Limitations on proposed solution

Initially and during the implementation stage few limitation related to the proposed solution were found.

- Limitations of project scope

  With the limited time constraint author used only the motion change as the only input for the system. In this case author could use many changes as the inputs for the system. As an example if the system trigger images of the environment system can detect the incident properly.

- Reliable to selected vehicles

This device more compatible with the luxury vehicle like cars, vans, busses. This might not working properly in the vehicle like two wheelers.

9.7 Future enhancements

There were many future enhancements encountered during the implementation stage and evaluation stage. Due to the time constraint those enhancements keep as future enhancements. Those are mention in the following table.

ID	Future enhancement	Description	Priority
FE01	Get the environment situation as an input.	Since system having only one input of velocity change, by capturing the environment system can increase the accuracy of collision detection	Medium
FE02	Collision report send to the nearest police and hospital station.	If the system can send the collision report to a nearest station recovering would be more quick	High
FE03	Implement on IOS platform	Since this project implementing only in the android platform, it is also good to implement on the IOS platform	low
FE04	Gather the whole path which vehicle travelled.	If the system can detect the whole travelled path, during a collision that detail also can be send to the relevant rescue parties to understand the accident place.	Medium

Table 22 - Future enhancements

9.8 Contribution

Motion Collision Detector for Automobiles (McDAM) project aim is to provide a solution for reduce the rescuing time in an accident and save lives of the victims. Existing solutions are developed as a hardware product and those are very expensive to install. This (McDAM) project contributing a mobile application which is easy to use and without any cost.

9.9 Concluding Remarks

This project mainly focusing on rescue the victims in an accident by informing the relevant parties to rescue the victim quickly. This presented project would be beneficial for the people who are travelling in vehicles often. By sending a message along with the relevant details during an accident to the relevant parties system helps supply a quick help to the victims. This solution can further develop by using those mentioned future enhancements in order to deliver a most accurate system than this and deliver a good contribution to the world.

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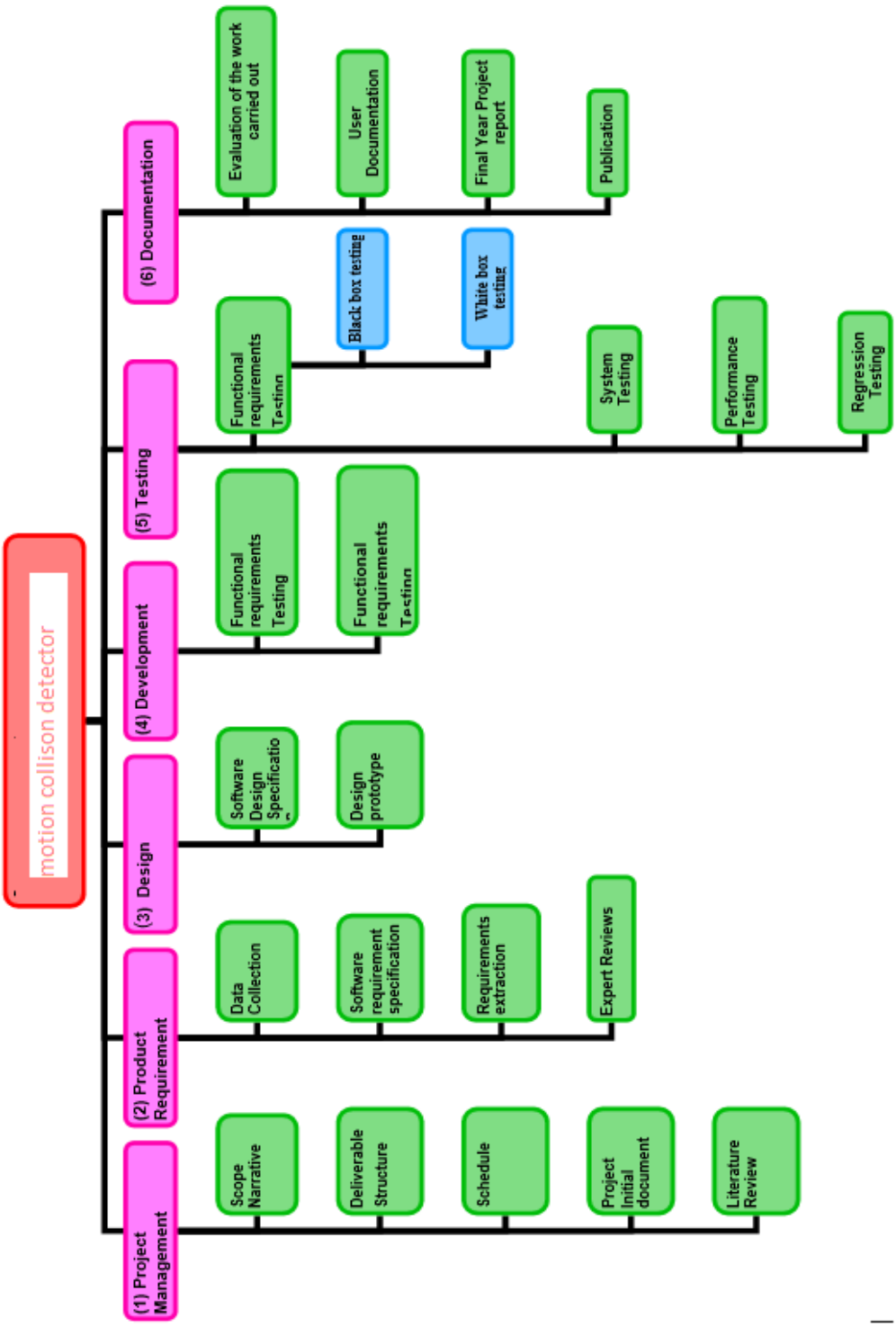
10 – Appendices

I. Work breakdown plan



II. Gantt chart

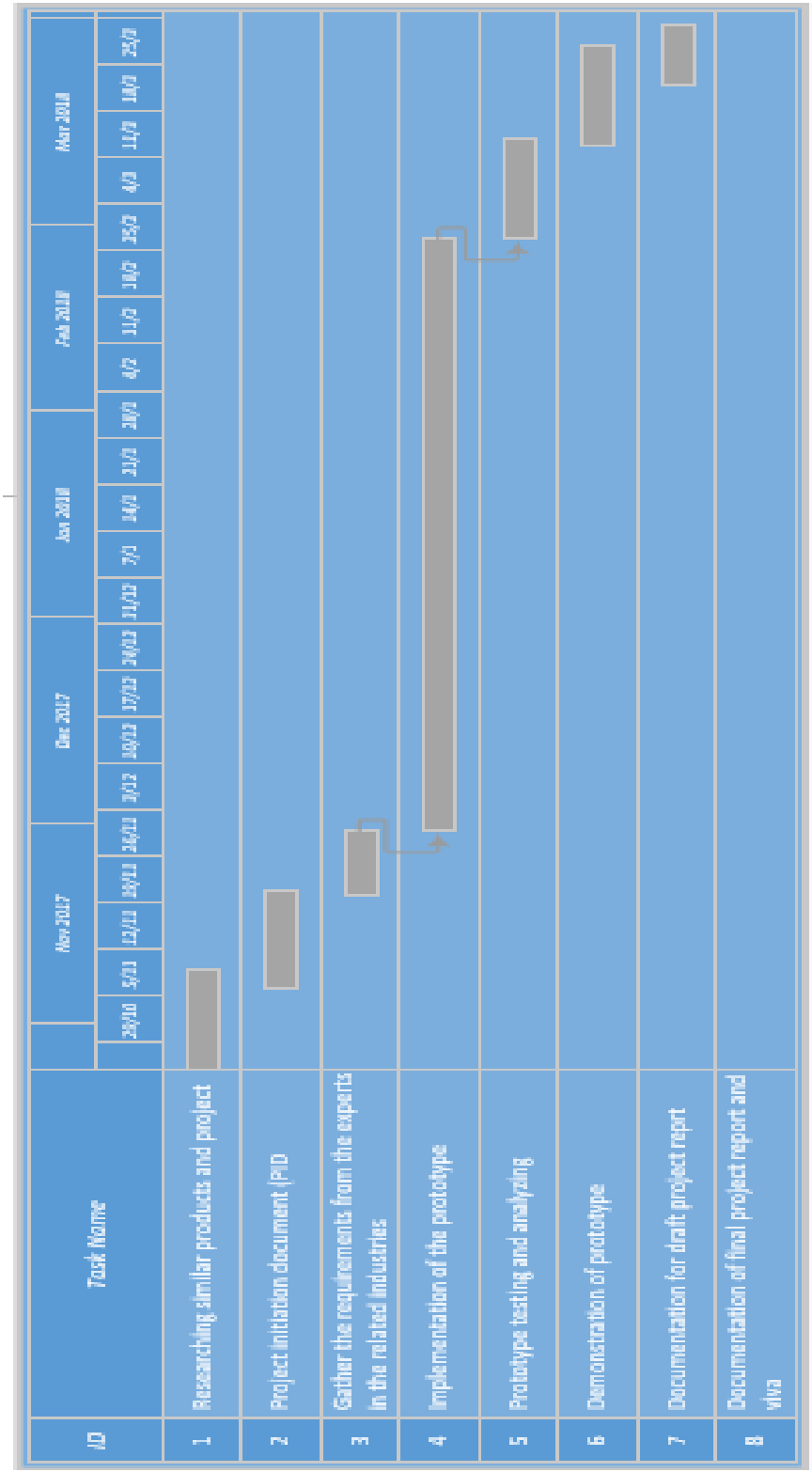


Figure 38 - Gantt chart

III. Online Questionnaire survey (Results)

1. What mobile platform you are using?

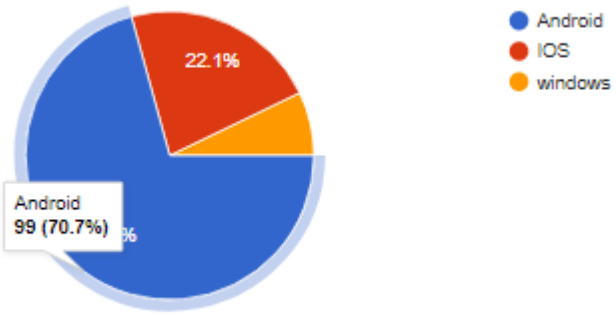


Figure 39 - Test result

2. How often do you travel by a vehicle?

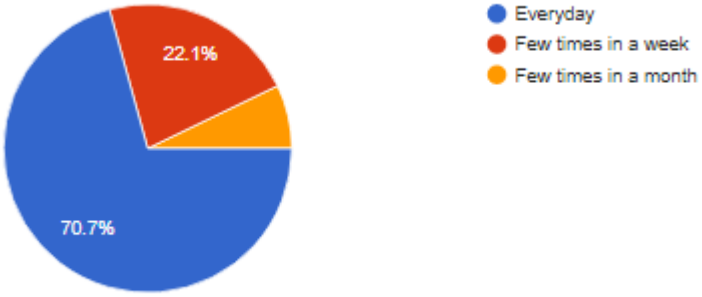


Figure 40 - Test result

3. In what type vehicle do you often travel?

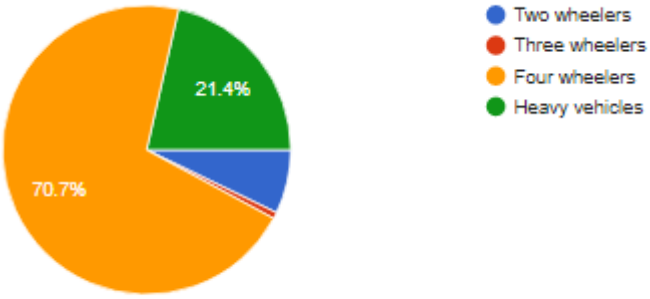


Figure 41 - Test result

4. Have you ever consider about a system to get immediate help in a motor accident ?

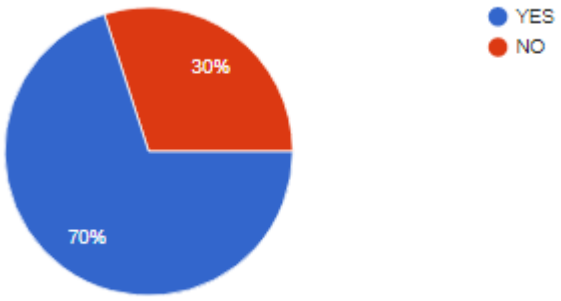


Figure 42 - Test result

5. what kind of system do you like to get a immediate help in an accident ?

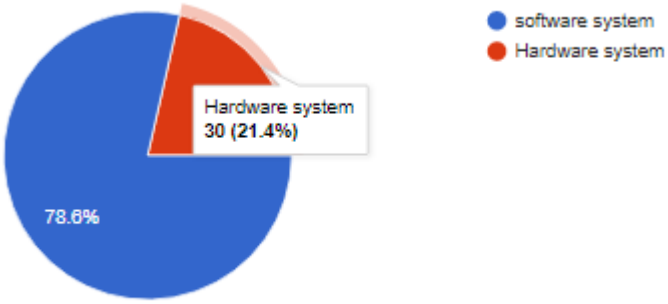


Figure 43 - Test result

6. Would you like to use a android application for get a immediate help when a accident happens ?

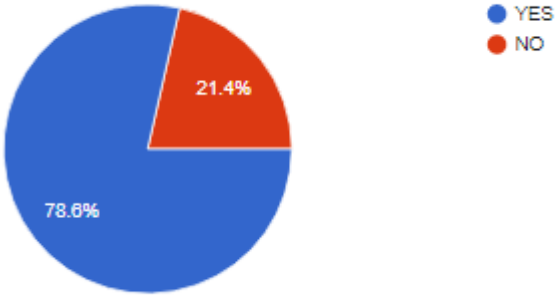


Figure 44 - Test result

7. If "yes" what type of features would you expect from a system like this ?

call police and hospital (96)
any (30)
take us to hospital (10)
To contact immediate support
call a relation
call relation
be alive

Figure 45 - Test result

8. Do you think this kind of application will be helpful to you ?

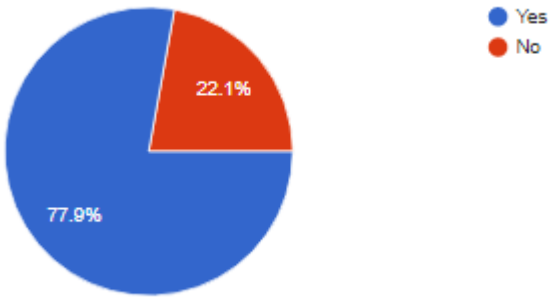


Figure 46 - Test result

9. If "yes" to the previous question , how do you expect the help ?

save my life (96)
any comment (30)
save life (11)
it will be usefull
will save my life
cal police

Figure 47 - Test result

10. Do you think you that you can get a help when an accident happens as you expect ?

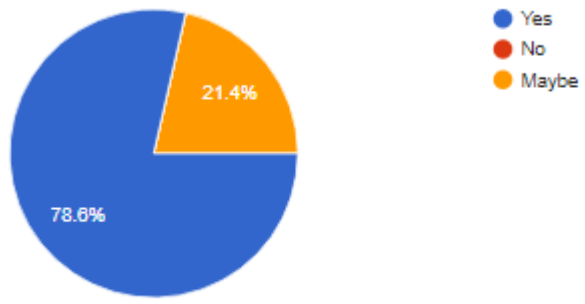


Figure 48 - Test result

IV - test results

MOBILE APPLICATION TEST CASES									
REQ_ID	**TS_ID**	**TEST OBJECTIVES**	**PRECONDITION**	**STEPS**	**TEST DATA**	**EXPECTED RESULTS**	**ACTUAL RESULTS**	**STATUS**	**DEFECT_ID**
1	1	To verify Application can open on a device	Application should be installed on the device	open the application	----------	Application should display detecting interface.	As expected	**Pass**	-
2	2	To verify application detecting interface.	1.Application should be opened. 2.Internet connection is required	open the application	----------	1.current speed of the vehicle should be displayed on top of the interface.	As expected	**Pass**	-

3	3	To verify application can detect movements similar t to what happens in an accident	Application should be opened	open the application	----------	1."Accident detected " interface should be displayed. 2.accident confirmation alert should be displayed. 3.60 second countdown should be started.	As expected	**Pass**	**-**
4.1	4	To verify accident identification functionality	1.Application should be opened. 2.Internet connection is required	1.open the application 2.apply the device into movements similar as accident	Movement patterns	1.application should alert the accident detected message. 2.60 second countdown should get started.	As expected	**Pass**	**-**
4.2	5	To verify accident alerting functionality	1.Application should be opened. 2.Internet connection is required	1.open the application 2.apply the device into movements similar as accident	Movement patterns informing phone numbers	1.Messages should be delivered to registered numbers after the countdown.	As expected	**Pass**	**-**

4.3	6	To verify the canceling functionality of accident alerting	1.Application should be opened. 2.Internet connection is required	1.open the application 2.apply the device into movements similar as accident 3.cancel the alert	----------	alert should be canceled and messages should not sent	As expected	**Pass**	-
4.4	7	To verify the confirming the accident before the countdown end	1.Application should be opened. 2.Internet connection is required	1.open the application 2.apply the device into movements similar as accident 3.confirm the alert	----------	messages should be sent to phone numbers	As expected	**Pass**	-
5	8	verifying the current location tracking functionality	1.Application should be opened. 2.Internet connection is required	1.Open the application 2.select the Google map from the menu.	----------	Map should show the current location of the vehicle	As expected	**Pass**	-
6.1	9	To verify user can register to the system with application	1.Application should be opened. 2.Internet connection is required	1.Open the application 2.select profile from menu 3.enter information 4.submit	First Name,Last Name, Address,Birthday,Blood group, Relative mobile number	"Registered successfully " message	As expected	**Pass**	-

6.2	10	To verify user can not register without filling required data	1.Application should be opened. 2.Internet connection is required	1.Open the application 2.select profile from menu 3.Enter less information 4.submit	Address,Birthday,Blood group, Relative mobile number	"Please enter required information" message	As expected	**Pass**	**-**
6.3	11	To verify user can not enter too lengthy or short mobile numbers.	1.Application should be opened. 2.Internet connection is required	1.Open the application 2.select profile from menu 3.Enter information 4.Enter Lengthy or short number 4.submit	First Name,Last Name, Address,Birthday,Blood group, Invalid mobile number	"Please enter a valid mobile number" message	As expected	**Pass**	**-**